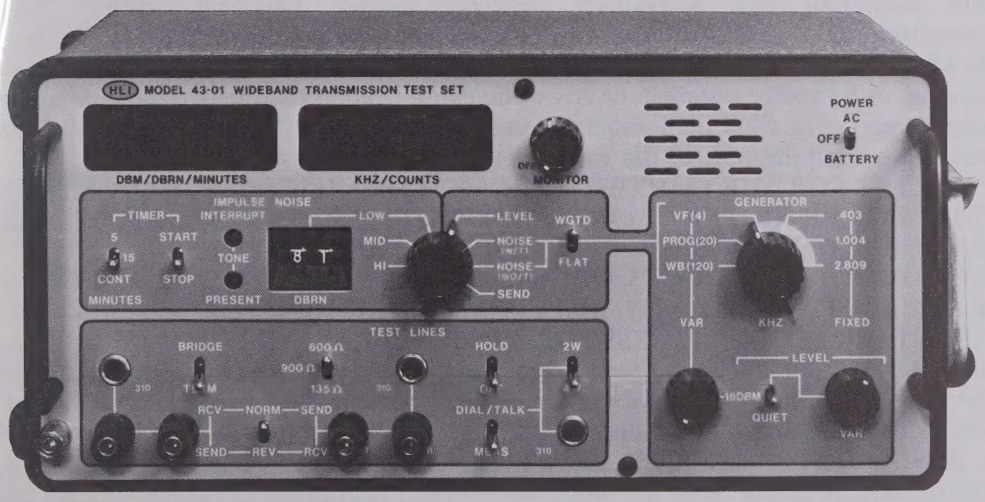
MODEL 43-01
WIDEBAND TRANSMISSION
TEST SET

SERVICE MANUAL

HLI® HEKIMIAN LABORATORIES INC.

PART NO. 43-01-M30
Issue 2, June 1986

SERVICE MANUAL
MODEL 43-01
WIDEBAND TRANSMISSION TEST SET



Manufactured by

HEKIMIAN LABORATORIES, INC.
9298 Gaither Road
Gaithersburg, Maryland 20877 USA
Telephone (301) 840-1217
Telex 215080

Copyright© Hekimian Laboratories, Inc. 1986

HLI STANDARD LIMITED WARRANTIES: DISCLAIMER OF WARRANTIES

Subject to the provisions hereof, Seller warrants the equipment manufactured by Seller and provided to Buyer pursuant to these Terms (the "Equipment") against any defect in design, materials, and workmanship that materially affects its performance (a "Defect") for a period (the "Warranty Period") of one year from the date of delivery thereof, except that the Seller shall, at its option and expense in accordance with the procedures described below, repair or replace ("Service") any Equipment that proves to have a Defect during the Warranty Period. This limited warranty is contingent upon Buyer's notifying Seller in writing within ten days following Buyer's discovery of an alleged Defect. Upon authorization by Seller following Seller's receipt of written notice from Buyer, the Equipment may be returned for Service, prepaid and at the sole cost and expense of Buyer, to the facility designated by Seller in such authorization. If examination of the returned Equipment by or on behalf of Seller discloses that any Service performed is not within the scope of this limited warranty, Seller shall invoice Buyer for the costs of examination and Service and for the cost of return of the Equipment to Buyer, and Buyer shall pay such costs within 30 days after receipt of such invoice. If such Service is within the scope of this limited warranty, Seller shall return the Equipment to Buyer at the sole cost and expense of Seller.

The limited warranty set forth herein shall not apply with respect to Defects resulting from neglect; misuse; accident; fire or other hazard, unauthorized alteration, modification or repair, including, without limitation, installation of unauthorized parts (provided, however, that minor adjustments by skilled personnel of Buyer following procedures prescribed by Seller will not invalidate such warranty); improper testing, handling, storage, operation, interconnection, or installation after installation of the equipment; failure to continually provide a suitable central office operating environment (including any necessary electrical, air conditioning, or humidity systems); or any other cause beyond the range of normal usage of the Equipment (except, in all of the foregoing cases, when caused by Seller). The limited warranty shall terminate upon any sale of the Equipment by Buyer.

EXCEPT FOR THE LIMITED WARRANTY SPECIFICALLY SET FORTH IN THIS SECTION, SELLER NEITHER MAKES, NOR ASSUMES ANY LIABILITY UNDER, ANY WARRANTIES (WHETHER EXPRESS, IMPLIED, OR STATUTORY) ON OR WITH RESPECT TO THE PRODUCTS OR ANY COMPONENTS THEREOF, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED CONDITIONS OR WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Any equipment not manufactured by Seller and any software provided to Buyer pursuant to these Terms is provided by Seller "AS IS": (subject to any equipment warranties which the manufacturer thereof makes available to Buyer). Service of Equipment, in the manner and for the period of time set forth above, shall be Buyer's exclusive remedy hereunder and shall constitute fulfillment of all liabilities of Seller to Buyer, whether based on contract, negligency or otherwise with respect to the Products delivered to Buyer hereunder.

Hekimian Laboratories, Inc.
9298 Gaither Road
Gaithersburg, Maryland 20877 USA

SERVICE MANUAL
MODEL 43-01 WIDEBAND TRANSMISSION TEST SET

CONTENTS PAGE

1. GENERAL 1-1
A. Functional Description 1-1
B. Specifications 1-2
2. POWER CONSIDERATIONS 2-1
A. AC Power 2-1
B. Model 43-50 Battery Charger . . 2-2
C. Model 43-01 Battery Pack (Option .02) 2-2
3. CONTROLS, JACKS AND DISPLAYS 3-1
A. Toggle Switches. 3-1
B. Knobs 3-2
C. Jacks 3-4
D. Displays and Speaker. 3-4
4. LINE INTERFACE AND DIAL/TALK, HOLD. 4-1
A. Impedance Selection 4-1
B. Bridge/Terminating Selection 4-1
C. Normal/Reverse Selection 4-1
D. 2-Wire Line Interface. 4-2
E. 4-Wire Line Interface. 4-2
F. 2-Wire Dial-Up. 4-2
G. 2-Wire Answer. 4-3
5. RECEIVE LEVEL AND FREQUENCY MEASUREMENT . . . 5-1
A. Measurement. 5-1
B. Overrange and Underrange Indications 5-1
6. NOISE MEASUREMENT 6-1
A. Measurement. 6-1
B. Overrange and Underrange Indications 6-2
7. IMPULSE NOISE MEASUREMENT. 7-1
8. SEND LEVEL AND FREQUENCY SETUP 8-1
9. MONITOR 9-1
10. SELF-TEST. 10-1
A. Initial Switch Settings 10-1
B. Generator, Level Meter and Frequency Counter Checks 10-1
C. Noise Meter and Filter Checks. 10-1
D. Impulse Noise Check. 10-3
11. THEORY OF OPERATION 11-1
A. General 11-1
B. Interface 11-1
C. Noise Filters 11-3
D. Level Meter 11-3
E. Timer 11-5
F. Impulse Noise Counter 11-6
G. Frequency Counter 11-7
H. Displays. 11-7
I. Monitor. 11-7
J. Generator 11-8
K. Power Supply 11-8
12. CIRCUIT LEVEL TROUBLESHOOTING 12-1
A. General 12-1
B. Power Supply 12-1
C. Generator 12-1
D. Interface 12-2
E. Noise Filters 12-2
F. Level Meter 12-3
G. Impulse Noise Counter 12-4
H. Timer 12-6
I. Frequency Counter 12-6
J. Displays. 12-7
K. Monitor. 12-7
13. CALIBRATION 13-1
A. General 13-1
B. 6 V Reference (ANALOG Board). 13-1
C. Send Level Adjustment (I/O Board) 13-1
D. Generator Fixed Level (GENERATOR Board) 13-1
E. Low Frequency Limit (GENERATOR Board) 13-1
F. High Frequency Response (I/O Board) 13-1
G. Receive Level Calibration (ANALOG Board). 13-2
H. C-MSG Filter Adjustment (I/O Board) 13-2
I. Notch Filter Alignment (I/O Board) 13-2
14. BOARD INSTALLATION AND REMOVAL 14-1

SERVICE MANUAL
MODEL 43-01 WIDEBAND TRANSMISSION TEST SET (Cont.)

CONTENTS

15. PACKING/SHIPPING AND RETURN TO FACTORY 15-1
A. Complete Unit. 15-1
B. Boards. 15-1
C. Individual Boards 15-1
16. PARTS LIST. 16-1
17. COMPONENT LAYOUTS AND SCHEMATIC DIAGRAMS 17-1

TABLES

A. Model 43-01 Specifications 1-2
B. C-MSG Filter Checks. 12-3
C. Program Filter Checks. 12-3
D. 50 kB Filter (497 F) Checks 12-3
E. 15 kHz Flat Filter Checks. 12-3
F. 3 kHz Flat Filter Checks. 12-3
G. Notch Filter Checks 12-3
H. Level Meter Gain Stages 12-5
I. Impulse Noise Gain 12-5
J. Parts List for Model 43-01 Assemblies. 16-1

FIGURES

1. Model 43-01 WIDEBAND TRANSMISSION TEST SET. 1-1
2. Rear Panel AC POWER Receptacle and Fuse 2-1
3. Front Panel AC POWER and BATTERY Switch and Ground Post. 2-1
3.1 Case Attachment Screw Locations . . 2-3
3.2 Bottom View of Model 43-01 with Case Removed 2-5
3.3 Battery Pack Plug and Power Supply Board Receptacle 2-5
4. Controls, Jacks and Displays 3-1
5. Line Interface Controls and Connectors 4-1
6. Receive Level and Frequency Measurements 5-1
7. Noise Measurement 6-1
8. Impulse Noise Measurement 7-1
9. Send Level and Frequency Setup . . . 8-1
10. Monitor. 9-1
11. Self-Test 10-1
12. Model 43-01 Block Diagram 11-2
13. Level Meter Block Diagram 11-4
14. Generator Block Diagram 11-9
15. Model 43-01 PC Board Identification 14-1
16. Assembly/Disassembly Screw Locations 14-2
17. Interface Board, Component Layout 17-2
18. Interface Board, Schematic Diagram. 17-3
19. Digital Board, Component Layout . 17-4
20. Digital Board, Schematic Diagram. . 17-5
21. Generator Board, Component Layout 17-6
22. Generator Board, Schematic Diagram. 17-7
23. Analog Board, Component Layout . 17-8
24. Analog Board, Schematic Diagram . 17-9
25. I/O Board, Component Layout . . . 17-10
26. I/O Board, Schematic Diagram . . . 17-11
27. Power Supply, Component Layout 17-12
28. Power Supply, Schematic Diagram 17-13

1. GENERAL

1.01 This manual contains information for the installation, operation and maintenance of the HLI Model 43-01 WIDEBAND TRANSMISSION TEST SET. This section covers the functional description and specifications of the Model 43-01.

DANGER: Hazardous voltages exist inside this instrument.

A. Functional Description

1.02 The Model 43-01 measures level, noise (VF, program and wideband), 3-level impulse noise, elapsed time and frequency. Combined with a variable signal generator and a flexible line interface configuration, the instrument will fill a variety of testing needs. The Model 43-01 is intended to comply with Bell System standards as contained in Bell System Technical Reference PUB 41009 dated May 1975. The instrument is compact (11" x 5-1/4" x 8-1/2") and weighs less than 11 pounds. When equipped with the optional battery the instrument is completely portable.

1.03 Level measurements are made directly in dBm using an average type detector. Noise measurements are made directly in dBrn using a quasi-RMS detector. C-message, program, 50 kBit (497 F), 3 kHz flat, 15 kHz flat and 50 kHz flat weighting filters are front panel selectable. The operator can select the holding tone notch to be in line with any of the weighting filters.

The Model 43-01 measures the number of times impulse noise (defined as any excursion of a band-limited signal above a preset threshold) occurs within a specified time period. The instrument is calibrated in dBrn to read the peak value of the received signal. The Bell Standard counting rate is provided. One set of thumbwheel switches allows the setting of low thresholds for impulse noise (metallic) tests. The LOW/MID, MID/HI threshold spread is 4 dB. Any of the noise weighting filters can be used for impulse noise testing.

Frequency measurements can be made from 30 Hz to 19.999 kHz with 1 Hz resolution in the VF mode and from 30 Hz to 120 kHz with 10 Hz resolution in the program and wideband modes.

1.04 Dual digital displays simultaneously present fully autoranged level/noise and manually ranged frequency measurements or impulse noise counts and elapsed time. Level and frequency measurements can be made

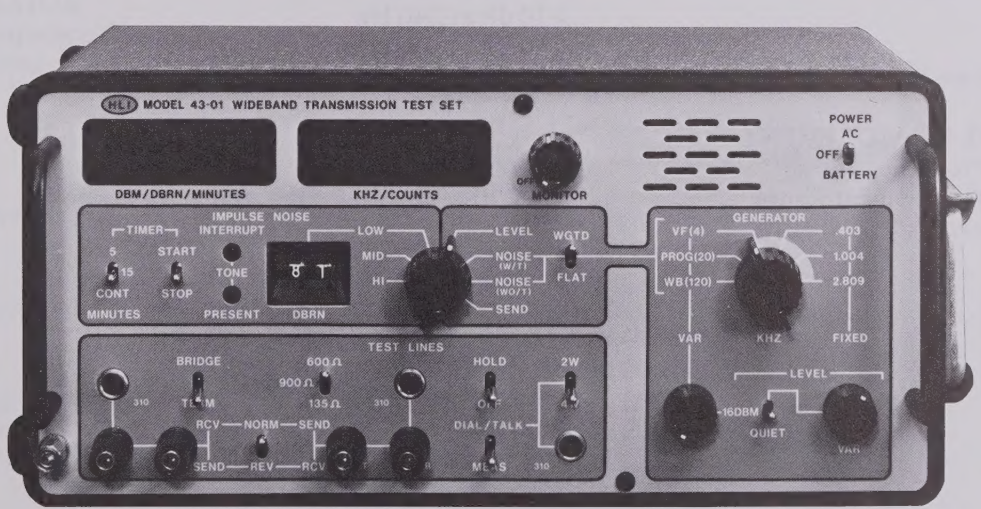


Figure 1. Model 43-01 WIDEBAND TRANSMISSION TEST SET

during impulse noise tests without affecting the impulse noise counting. A loss-of-tone indicator shows if the holding tone was lost at any time during an impulse noise test.

1.05 The signal generator provides continuous frequency coverage in three overlapping ranges. For noise measurements, both a 1004 Hz holding tone and a quiet termination are provided. Additionally, the instrument features fixed frequencies of 403 Hz and 2809 Hz. The operator can select a fixed level, variable level or a quiet termination via a single, three position toggle switch.

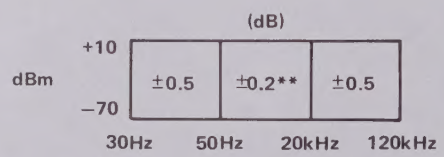
1.06 Line interface can be made to either the 310 jacks or the five-way binding posts on the front panel. The instrument is supplied with 135 Ω, 600 Ω and 900 Ω selectable send/receive impedances, line bridging and termination selection capability and an audio monitor. A full 2W/4W dial/talk capability with dual electronic hold circuits is provided.

B. Specifications

1.07 Specifications for the Model 43-01 are contained in Table A.

TABLE A. MODEL 43-01 SPECIFICATIONS*

GENERAL	
Measurements	Level (dBm), noise (dBrn), 3-level impulse noise, time (min.), frequency (kHz)
Displays	Dual display
Generator	Sine wave, fixed and variable frequency, fixed and variable level
Dial/Talk	Full 2W/4W capability with dual electronic hold
Line Select	Send/receive transfer switch
Audio Monitor	Front panel volume control and ON/OFF switch
INPUT	
Impedance	135 Ω, 600 Ω, 900 Ω, bridged (balanced)
Return Loss	>30 db, 200 Hz to 20 kHz (600 Ω, 900 Ω)
Balance	>80 db at 60 Hz >70 db at 540 Hz >60 dB at 4 kHz
Line Hold	Electronic hold, nominal 26 mA
LEVEL MEASUREMENT	
Frequency Range	30 Hz to 120 kHz
Measurement Range	-90.0 dBm to +10.0 dBm, full autoranging
Accuracy	



**±0.1 dB at 1000 Hz for levels between 0 and -19 dB.

Detector Type	Average

TABLE A. MODEL 43-01 SPECIFICATIONS (Cont.)*

NOISE MEASUREMENT	
Modes	Noise (message circuit)
Weighting Filters	C-Message, 3 kHz flat, program, 15 kHz flat, 50 kBit (497 F), 50 kHz flat, 1010 Hz notch
Measurement Range	0 to +100 dBrn (noise), full autoranging
Accuracy	±1 dB (noise), +10 to +100 dBrn ±2 dB, 0 to + 10 dBrn
Detector Type	Quasi-RMS
IMPULSE NOISE MEASUREMENT	
Measurement Range	40 dBrn to 107 dBrn
Low Threshold Settings	40 dBrn to 99 dBrn
Accuracy	±1 db
Weighting Filters	C-Message, 3 kHz flat, program, 15 kHz flat, 50 kBit, 50 kHz flat
Lo/Mid, Mid/High Threshold Spread	4 dB
Maximum Count Rate	7 counts per second (Bell Standard)
Count Capacity	9999
Timer	5, 15 minutes or continuous
FREQUENCY MEASUREMENT	
Frequency Range	30 Hz to 120 kHz; 1 Hz resolution to 19.999 kHz in VF mode, 10 Hz resolution in program and wideband modes
Level Range	−40 dBm to +10 dBm
Accuracy	±0.005% ±1 least significant digit
S/N Requirement	⩾20 dB
GENERATOR	
Frequency Range	50 Hz to 120 kHz
Modes	VF: 50 Hz to 4.8 kHz Program: 250 Hz to 24 kHz Wideband: 1250 Hz to 120 kHz 403 Hz, 1004 Hz, 2809 Hz, crystal controlled
Level Range	−40 dBm to +10 dBm, continuously adjustable −16 dBm, fixed (set at 100 Hz) Quiet termination
Distortion	>60 dB, 1004 Hz fixed >50 dB, 200 Hz to 4000 Hz >40 dB, 50 Hz to 120 kHz
Impedance	135 Ω, 600 Ω, 900 Ω (balanced)
Return Loss	>30 dB, 200 Hz to 20 kHz (600 Ω)

TABLE A. MODEL 43-01 SPECIFICATIONS (Cont.)*

CONNECTORS	
Send-Receive	310 type jacks, 5-way binding posts
4W Talk	310 type jack
2W Dial/Talk	310 type jack
POWER	105-130 V ac 57-63 Hz, 15 Watts
SIZE	11" (27.94 cm.) W x 5¼" (13.34 cm.) H x 8½" (21.59 cm.) D, less cover
WEIGHT	10.3 lbs. (4.6 kg.) ac only 12.5 lbs. (5.7 kg.) with battery pack
OPTIONS	.01 220 V ac operation .02 Rechargeable battery pack

*All stated and unstated specifications are intended to comply with Bell System standards as contained in Bell System Technical Reference PUB 41009 dated May 1975.

HLI reserves the right to make changes in specifications at any time without notice.

2. POWER CONSIDERATIONS

A. AC POWER

2.01 This section contains information pertaining to the ac power connection and power source compatible with the Model 43-01.

2.02 The Model 43-01 may be operated from a source of 105 V ac to 130 V ac at line frequencies from 57 Hz to 63 Hz. The fuse, located on the rear panel as shown in Figure 2, is a 0.5 ampere slow-blow. A small flat-blade screwdriver is used to replace the fuse.

2.03 The Model 43-01 is supplied with a detachable three-conductor power cable (Belden P/N KH-8828R) which, when plugged into an appropriate receptable (located on the rear panel as shown in Figure 2), grounds the chassis to the power line ground. To retain this protective feature when the power cable is plugged into a two-wire outlet, use a three-conductor to two-conductor adapter and connect the adapter wire to an appropriate ground.

2.04 If for any reason the chassis cannot be grounded through the power cable, it is recommended that the Model 43-01 be grounded via the front panel (refer to Figure 3) ground post.

2.05 When the unit is received, it is recommended that the self-test in Section 10 be performed to determine that the unit is electrically operational.

Figure 2. Rear Panel AC Power Receptacle and Fuse

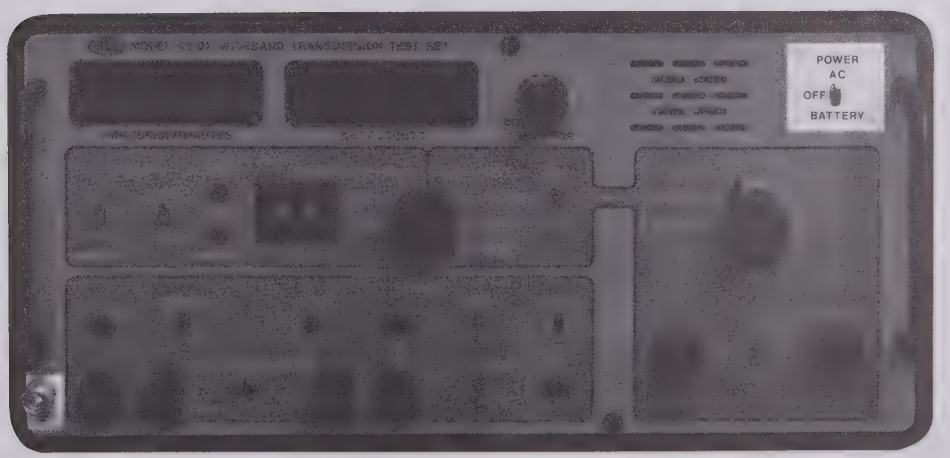


Figure 3. Front Panel AC POWER and BATTERY Switch and Ground Post

B. Model 43-50 Battery Charger

2.06 This section contains information pertaining to the Model 43-50 battery charger. Earlier Model 43-01 units incorporated this capability only if they were ordered along with the Model 43-50. This capability is now standard with all Model 43-01's.

2.07 The Model 43-50 contains four 1.2 ampere-hour nickel-cadmium batteries. To recharge these batteries, connect the battery charging cable to the Model 43-50 front panel charger connector and to the charger connector on the rear panel of the Model 43-01. With the cable connected, the batteries will be recharging whenever the Model 43-01 power cord is connected to an ac line. The batteries will recharge faster if the power switch on the Model 43-01 is set to the OFF position. Additional information can be found in Section 3 of the Model 43-50 Operating Manual (43-50-M20).

C. Model 43-01 Battery Pack (Option .02)

2.08 This section contains information on the Model 43-01 Rechargeable Battery Pack, Option .02. When fully charged, the battery pack will operate the Model 43-01 for approximately four hours.

2.09 The rechargeable battery pack consists of three independent nickel-cadmium batteries. Two of these are 9 V batteries with eight matched cells and a cutoff point of 8.8 V dc. At full charge the battery voltage may be as high as 11.0 V dc. The 5 V battery has four matched cells and a cutoff point of 4.4 V dc. When fully charged the voltage may be as high as 5.5 V dc.

2.10 The battery chargers are active when the unit is connected to the ac line. The batteries can be recharged simultaneously with ac operation, but will charge faster when the Model 43-01 power switch is set to the OFF position. Fully discharged batteries can be fully recharged overnight (14-16 hours) at 25°C with the power switch set to OFF.

Replacement Battery Packs

2.11 While the Model 43-01 battery pack is rechargeable, extended use of the test set may wear out the battery pack. A replacement battery pack can be ordered from the factory.

Note: There are two types of Model 43-01 battery packs. They are not interchangeable and installing the wrong type will seriously damage your test set.

To avoid damaging the Model 43-01, use the following instructions when you replace the battery pack.

How to Order a Replacement Battery Pack

2.12 To ensure you receive a battery pack that is compatible with your Model 43-01, do the following:

- Record the serial number of the test set needing the battery pack replacement.
- Contact the HLI Customer Service Department to order the new battery pack.
- Indicate your Model 43-01 serial number when placing the order.
- If the serial number of your test set is between 1 and 299, you must send the failed battery pack back to the factory for proper identification. Obtain the shipping instructions from the Customer Service Department when you place the replacement order. (If the serial number of your test set is 300 or above, you do not have to send the failed battery pack back to the factory.)

How to Remove the Battery Pack

2.13 This section describes the Model 43-01 battery pack removal procedure. To perform this procedure, you will need a 3/16" flat blade screwdriver.

To remove the battery pack, perform the following steps:

1) Set the POWER switch to the OFF position.

DANGER: If the power cord is connected, hazardous voltages exist inside this unit. Disconnect the power cord from the three prong receptacle on the rear of the test set before proceeding.

2) Remove the case and handle attachment screws and the case and bottom feet attachment screws identified in Figure 3.1. (The handle and bottom feet attachment screws also secure the case to the Model 43-01.)

3) Remove the case by pulling it from the rear and sliding it off the test set. You may find it necessary to use a screwdriver to pry the case from the front panel frame.

4) Turn the Model 43-01 so the bottom of the test set faces up and the front panel faces away from you, as shown in Figure 3.2.

5) Locate the battery pack plug using Figure 3.2 as a guide.

WARNING: Do not use a screwdriver, or other metallic tool, to pry the battery pack plug from the power supply board receptacle. An inadvertant slip could short the unit, causing serious damage.

6) Grasp the battery pack plug between your thumb and index finger, being careful not to pull on the wire harness.

7) Pull the battery pack plug firmly upward and at a slight angle to the power supply board to disconnect the plug from the receptacle.

8) Remove the four slotted screws securing the battery pack retainer plate.

9) Lift the retainer plate off the battery pack.

10) Lift the battery pack out of the unit.

For test sets with serial numbers 1 through 299, package the used battery pack for shipment and return it to the factory.

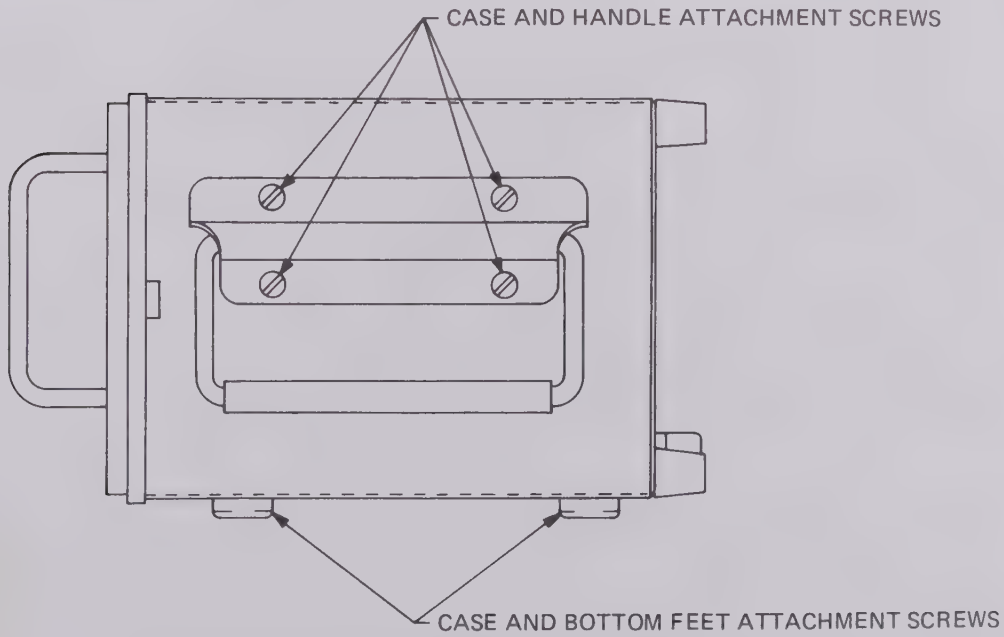


Figure 3.1. Case Attachment Screw Locations

How To Install the Battery Pack

2.14 This section describes how to install the rechargeable battery pack in a Model 43-01. To perform this procedure, you will need a 3/16" flat blade screwdriver.

To install the battery pack, perform the following steps:

1) Set the POWER switch to the OFF position.

DANGER: If the power cord is connected, hazardous voltages exist inside this unit. Disconnect the power cord from the three prong receptacle on the rear of the test set before proceeding.

2) Remove the case and battery pack retainer plate if they have not already been removed. (If you are not sure how to remove the case and retainer plate, refer to the section entitled "How To Remove the Battery Pack".)

3) Place the battery pack in the battery pack compartment, making sure the wire harness extends from the right side of the battery pack, as shown in Figure 3.2.

4) Place the battery pack wire harness around the power transformer as shown in Figure 3.2.

WARNING: Incorrect installation of the battery pack plug, even momentarily, causes damage to the test set.

5) Orient the battery pack plug directly above the power supply board receptacle so the locking tabs on the side of the plug face toward the locking latch on the receptacle, as shown in Figure 3.3.

6) Carefully align the plug with the receptacle so that each of the nine pins mates with a socket.

7) Press the plug downward onto the receptacle pins until the locking latch engages the locking tabs.

8) Install the battery pack retainer plate, taking care not to pinch the wire harness under the retainer plate.

9) Slide the case onto the test set chassis.

10) Install the handle assembly and the four bottom feet as shown in Figure 3.1 to secure the case.

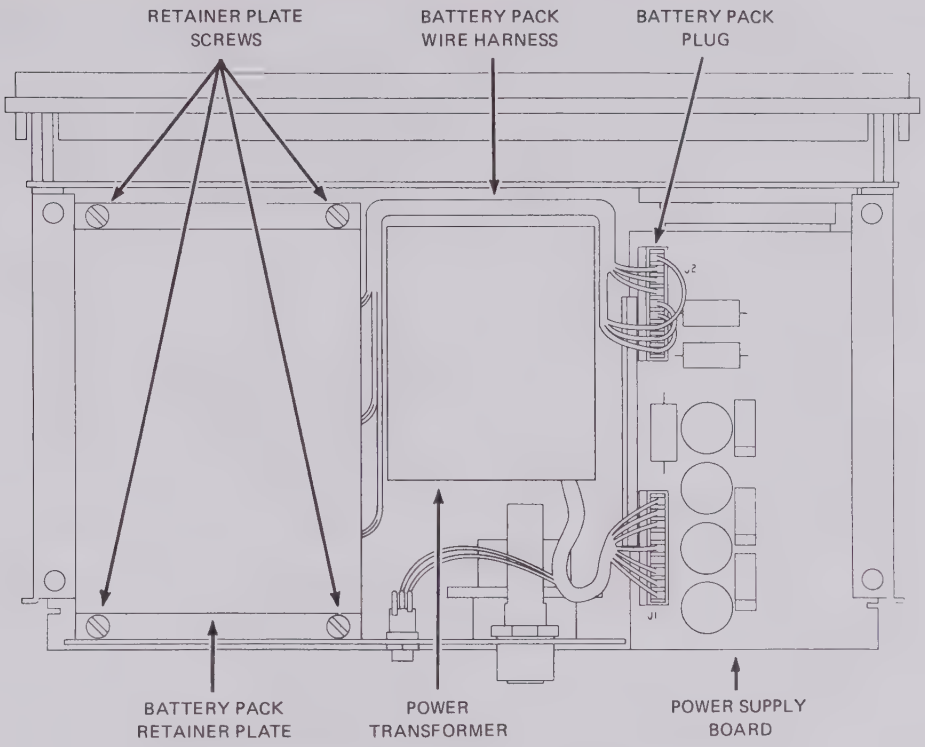


Figure 3.2. Bottom View of Model 43-01 With Case Removed

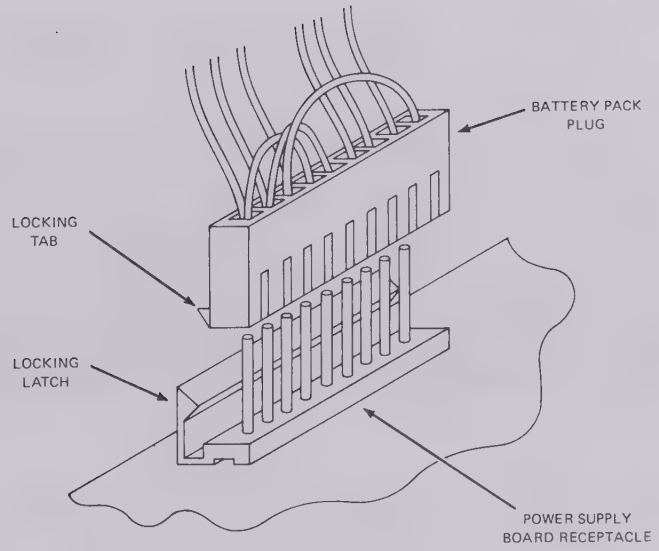


Figure 3.3. Battery Pack Plug and Power Supply Board Receptacle

3. CONTROLS, JACKS AND DISPLAYS

3.01 This section contains the description of all toggle switches, knobs, jacks, displays and the speaker on the Model 43-01. Refer to Figure 4 for the location of all items discussed.

A. Toggle Switches

(1) WGTD/FLAT - With the switch set to the WGTD position the user can select C-message, program, or 50 kBit (497F) noise weighting filters. With the switch set to the FLAT position the user can select 3 kHz flat, 15 kHz flat, or 50 kHz flat noise weighting filters.

(7) IMPULSE NOISE TIMER START/STOP - When the switch is momentarily pressed to the START position, the impulse noise timer will start and the Model 43-01 will be able to accumulate impulse noise counts. When the switch is momentarily pressed to the STOP position, the impulse noise timer will stop and the Model 43-01 will be unable to accumulate any additional impulse noise counts.

(8) IMPULSE NOISE TIMER 5/15/CONT MINUTES - With the switch set to the 5 position the impulse noise timer will automatically stop 5 minutes after the START/STOP switch is momentarily pressed to the START position. Setting the switch to the 15 position causes the impulse noise timer to automatically stop 15 minutes after the START/STOP switch is momentarily pressed to the START position. With the switch in the CONT position the impulse noise timer will continuously count after the START/STOP switch is momentarily pressed to the START position. The timer will stop when the START/STOP switch is momentarily pressed to the STOP position.

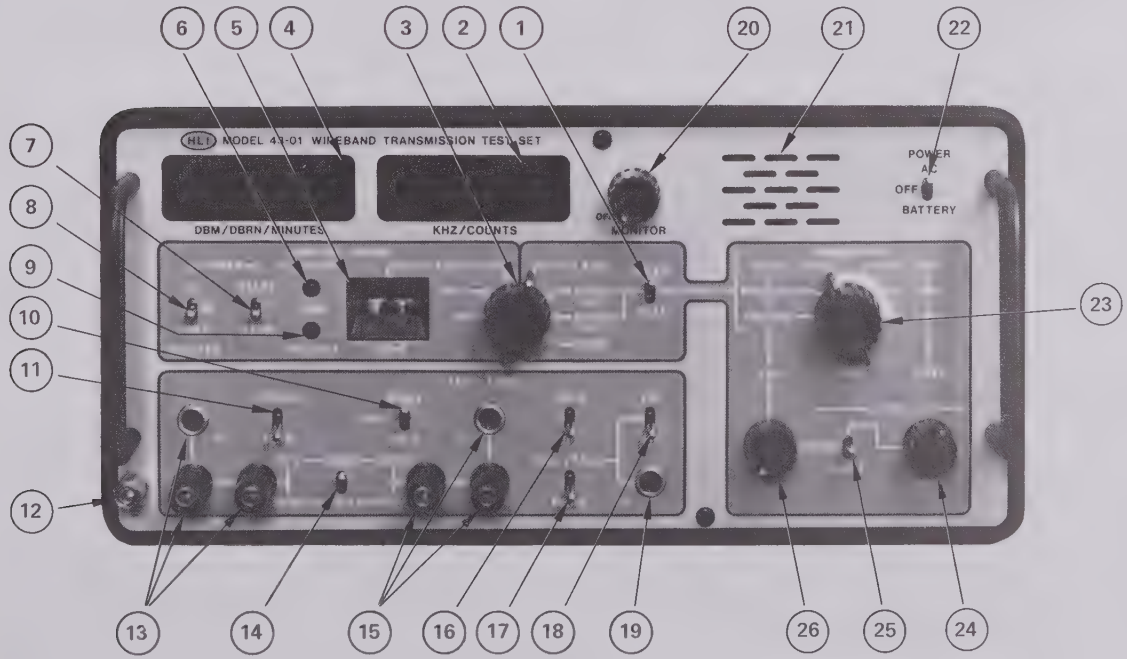


Figure 4. Controls, Jacks and Displays

(10) 600 Ω/900 Ω/135 Ω - Selects send/receive terminating impedances of 600Ω, 900 Ω, or 135 Ω.

(11) BRIDGE/TERM - Provides termination of both the send and receive lines when set to the TERM position. When set to the BRIDGE position the Model 43-01 is set to bridge across the receive line.

(14) NORM/REV - When set to the NORM position the jack to the right of the switch is the send jack (15) and the jack to the left of the switch is the receive jack (13). When set to the REV position the functions of the jacks are reversed.

(16) HOLD/OFF - When set to HOLD dual electronic hold circuits are placed across the send and receive lines (during 2-wire dial/talk operation, the hold circuit will not be across the send line).

(17) DIAL/TALK/MEAS - When set to the DIAL/TALK position the user can perform both 2-wire or 4-wire dial/talk functions. When set to MEAS the Model 43-01 is set to perform circuit measurements.

(18) 2W/4W - Sets up dial/talk for 2-wire or 4-wire operation. When set to the 2W position the Model 43-01 directly accesses the send line for 2-wire (wet) and double 2-wire (wet) facilities. When set to 4W the Model 43-01 provides talk battery for 4-wire (dry) facilities.

(22) AC/OFF/BATTERY (Battery Optional) - Three position switch that controls power to the unit. If your Model 43-01 has the battery option, the BATTERY position should only be used if ac power is not available. The battery will be charging whenever the ac power cord is plugged in.

(25) VAR/-16DBM/QUIET - With the switch set to the VAR position the send level is adjustable from −40 dBm to +10 dBm. When the switch is in the −16 DBM position the send level is a fixed −16 dBm. Setting the switch to QUIET provides a quiet termination at the send jack for noise measurements.

B. Knobs

(3) Measure Function Knob - This knob performs the listed functions when set to the following positions:

HI - Left-hand display will show the elapsed time of the impulse noise measurement. Right-hand display will show the number of times an impulse noise occurrence exceeded the high threshold (low threshold setting +8 dB).

MID - Left-hand display will show the elapsed time of the impulse noise measurement. Right-hand display will show the number of times an impulse noise occurrence exceeded the mid threshold (low threshold setting +4 dB).

LOW - Left-hand display will show the elapsed time of the impulse noise measurement. Right-hand display will show the number of times an impulse noise occurrence exceeded the low threshold (set by the IMPULSE NOISE DBRN thumbwheel switch (5)).

LEVEL - Left-hand display will show the received level in dBm referenced to the selected terminating impedance. Right-hand display will show the received frequency in kHz.

NOISE (W/T) - Left-hand display indicates the level (expressed in dBrn) of the notched noise after filtering by the selected noise weighting filter. Right-hand display will be blanked.

NOISE (WO/T) - Left-hand display shows the level (expressed in dBrn) of the noise after filtering by the selected noise weighting filter. Right-hand display will be blanked.

SEND - Left-hand display will show the send level in dBm referenced to the selected line impedance. Right-hand display will show the send frequency in kHz.

(5) IMPULSE NOISE DBRN Thumbwheel Switch - Sets the desired low threshold, from 40 dBrn to 99 dBrn, for impulse noise measurements.

(20) MONITOR - With knob set to the OFF position the audio speaker on the front panel will be shut-off. By turning the knob clockwise from the OFF position the volume from the speaker will be increasing.

(23) GENERATOR Knob - The GENERATOR knob is a multi-purpose control. When the Model 43-01 is receiving the knob is used to select the desired noise weighting filter. When the Model 43-01 is sending the knob is used to select the desired variable frequency range or the desired fixed frequency. This knob also controls the frequency range of the frequency counter. With knob in the following positions the corresponding function will be realized.

WB (120) - With the Model 43-01 in the noise measurement mode the wideband noise weighting filters [50 kBit (497F) or 50 kHz flat] are selected, depending upon the position of the WGTD/FLAT toggle switch. With the Model 43-01 in the send mode, the 120 kHz variable generator range (1250 Hz to 120 kHz) is selected. Also selects the 199.99 kHz frequency measurement range.

PROG (20) - In the noise measurement mode the program noise weighting filters (Program or 15 kHz flat) are selected, depending upon the position of the WGTD/FLAT toggle switch. In the send mode the 20 kHz variable generator range (250 Hz to 24 kHz) is selected. Selects the 199.99 kHz frequency measurement range.

VF (4) - In the noise measurement mode the voice frequency noise weighting filters (C-message or 3 kHz flat) are selected, depending upon the position of the WGTD/FLAT toggle switch. In the send mode the 4 kHz variable generator range (50 Hz to 4.8 kHz) is selected. The frequency counter's measurement range is set at 19.999 kHz.

.403 - Selects the 403 Hz fixed send frequency. In this position the voice frequency noise weighting filters (C-message or 3 kHz flat) are selected, depending upon the position of the WGTD/FLAT toggle switch. The frequency counter's measurement range is set at 19.999 kHz.

1.004 - Selects the 1004 Hz fixed send frequency. In this position the voice frequency noise weighting filters (C-message or 3 kHz flat) are selected, depending upon the position of the WGTD/FLAT toggle switch. The frequency counter's measurement range is set at 19.999 kHz.

2.809 - Selects the 2809 Hz fixed send frequency. In this position the voice frequency noise weighting filters (C-message or 3 kHz flat) are selected, depending upn the position of the WGTD/FLAT toggle switch. The frequency counter's measurement range is set at 19.999 kHz.

(24) LEVEL VAR - Used to adjust the send level from -40 dBm to +10 dBm.

(26) VAR - Used to adjust the send frequency from 50 Hz to 4.8 kHz in the VF (4) mode, 250 Hz to 24 kHz in the PROG (20) mode and 1250 Hz to 120 kHz in the WB (120) mode.

C. Jacks

(12) Ground Post - The Model 43-01 chassis is normally grounded through the power line. Where three-conductor power line is not available the chassis should be grounded via this post.

(13) Left-Hand Line Interface Jacks - The user can connect to the 310 jack (tip and ring) or the 5-way binding post (tip and ring). The sleeve of the 310 jack is connected to chassis ground. These jacks serve as the receive jacks when the NORM/REV switch is set to NORM and as the send jacks when the NORM/REV switch is set to REV.

(15) Right-Hand Line Interface Jacks - The user can connect to the 310 jack (tip and ring) or the 5-way binding post (tip and ring). The sleeve of the 310 jack is connected to chassis ground. These jacks serve as the send jacks when the NORM/REV switch is set to NORM and as the receive jack when the NORM/REV switch is set to REV.

(19) DIAL/TALK 310 Jack - This jack is provided for the connection of a lineman's handset, other dialing facility or a headset during dial/talk operations. The sleeve of this 310 jack is connected to chassis ground.

D. Displays and Speaker

(2) Right-Hand Display - This display indicates frequency in KHZ when the measure function knob is set to LEVEL or SEND. It will indicate the number of impulse noise occurrences above the low, mid and high thresholds when the measure function knob is set to LOW, MID and HI, respectively. When the measure function knob is set to NOISE (W/T) or NOISE (WO/T) this display will be blanked.

(4) Left-Hand Display - This display indicates level in dBm when the measure function knob is set to LEVEL or SEND. It will indicate the level of the received noise when the measure function knob is set to NOISE (W/T) or NOISE (WO/T). Finally, it will show the elapsed time, in minutes, of an impulse noise measurement when the measure function knob is set to HI, MID or LOW.

(6) IMPULSE NOISE TONE INTERRUPT - This indicator will light and stay lit if the holding tone is lost during an impulse noise measurement.

(9) TONE PRESENT - This indicator will light whenever a valid holding tone is present.

(21) Speaker - The speaker provides various audible signals depending upon the position of the measure function knob. When the measure function knob is set to HI, MID or LOW the speaker will monitor the signal being fed to the impulse noise circuitry; when the measure function knob is set to LEVEL or SEND the speaker will monitor the receive and send signal, respectively. Finally, when the measure function knob is set to NOISE (W/T) or NOISE (WO/T), the speaker will monitor the signal after it has been conditioned by the noise weighting filters.

4. LINE INTERFACE AND DIAL/ TALK, HOLD

4.01 This section describes the line interface connections required to perform the measurements described in subsequent sections of this manual. Also described in this section are the operating instructions for the 2-wire/4-wire dial/talk and hold capabilities of the Model 43-01.

4.02 The Model 43-01 has two sets of balanced terminals and is capable of sending and receiving signals simultaneously. The operator can interface to the Model 43-01 by either the 310 jacks or the 5-way binding posts on the front panel. When using the 310 jacks, be sure to use a WECO 310 plug or equivalent, use of any other type of plug can deform the contacts of the 310 jack. Refer to Figure 5 while performing the procedures in this section.

A. Impedance Selection

4.03 The Model 43-01 provides three commonly used terminating impedances, 135 Ω, 600 Ω, and 900 Ω. The desired impedance is selected by setting the 135 Ω/900 Ω/600 Ω toggle switch to the appropriate position.

Note: Failure to select the proper impedance will cause errors in both the send and receive levels.

B. Bridge/Terminating Selection

4.04 The Model 43-01 can be bridged across the received line by setting the BRIDGE/TERM switch to the BRIDGE position. In the bridge mode, the send and receive levels are referenced to the selected terminating impedance (135 Ω, 600 Ω, or 900 Ω). When the Model 43-01 is going to terminate the received line, set the BRIDGE/TERM switch to the TERM position.

C. Normal/Reverse Selection

4.05 The NORM/REV switch enables the function of the send/receive jacks to be interchanged and may be used in 2-wire or 4-wire operation. When the NORM/REV switch is set to NORM, the right-hand jacks function as

Figure 5. Line Interface Controls and Connectors

the SEND jacks and left-hand jacks function as the RCV (receive) jacks. Setting the NORM/REV switch to REV reverses the functions of the jacks with the right-hand jack becoming the RCV (receive) jack and the left-hand jack the SEND jack.

D. 2-Wire Line Interface

4.06 In order to interface to a 2-wire line, proceed as follows:

1) Set DIAL-TALK/MEAS to MEAS.
2) If it is necessary to hold the line under test, set HOLD/OFF to HOLD.
3) Set BRIDGE/TERM to the desired position (see paragraph 4.04).
4) Set the 135 Ω/900 Ω/600 Ω switch to match the line impedance.
5) Set the NORM/REV switch to NORM in order to send.
6) Set the NORM/REV switch to REV in order to receive.
7) Set the 2W/4W switch to 2W.
8) Connect the 2-wire line under test to either the NORM-SEND 310 jack or 5-way binding posts.

4.07 Since the Model 43-01 is available with electronic hold circuits for both the SEND and RCV jacks, the NORM-RCV jacks can also be used for 2-wire line interface.

E. 4-Wire Line Interface

4.08 To interface with 4-wire lines, proceed as follows:

1) Set DIAL-TALK/MEAS to MEAS.
2) SET HOLD/OFF to OFF.
3) Set BRIDGE/TERM to the desired position (see paragraph 4.04).
4) Set the 135 Ω/900 Ω/600 Ω switch to match the line impedance.
5) Set the NORM/REV switch to NORM.
6) Set the 2W/4W switch to 4W.
7) Connect the send line to the NORM-SEND 310 jack or 5-way binding posts.
8) Connect the receive line to the NORM-RCV 310 jack or 5-way binding posts.

F. 2-Wire Dial-Up

4.09 The Model 43-01 is equipped with a versatile dial/talk circuit that enables a lineman's handset to be used in 2-wire operation. The following instructions assume that the dialing facility used has a listener output. If a simple dial is used that does not have an audible listener output, the Model 43-01's internal monitor speaker and volume control can be used to determine the presence of a dial tone and that the called line answered after dialing. In order to perform the following procedure, a lineman's handset or equivalent dialing facility (e.g. telephone set with a rotary dial) is required.

4.10 To dial-up on a single 2-wire wet line, proceed as follows:

1) Set the HOLD/OFF switch to OFF.
2) Set DIAL-TALK/MEAS to DIAL/TALK.
3) Set 2W/4W to 2W.
4) Set BRIDGE/TERM to the desired position (see paragraph 4.04).
5) Set the 135 Ω/900 Ω/600 Ω switch to match the line impedance.
6) Set the NORM/REV switch to NORM.
7) For single 2-wire line, connect the line under test to the NORM SEND 310 jack or 5-way binding posts.
8) Connect the Model 43-01 chassis ground post ⏚ to the local ground or the sleeve (shield) of the 2-wire line undergoing test.
9) Connect the lineman's handset to the DIAL/TALK 310 jack.
10) Depress the off-hook button or turn on the off-hook switch on the lineman's handset.
11) Listen for a dial tone from the handset, then proceed to dial the desired number.

12) When the call is answered, set the HOLD/OFF switch to the HOLD position.
13) To return to the testing mode of operation, set the DIAL-TALK/MEAS switch to the MEAS position.

4.11 To dial-up on a double 2-wire line, proceed as follows:

1) Set the HOLD/OFF switch to OFF.
2) Set DIAL-TALK/MEAS to DIAL/TALK.
3) Set 2W/4W to 2W.
4) Set BRIDGE/TERM to the desired position (see paragraph 4.04).
5) Set the 135 Ω/900 Ω/600 Ω switch to match the line impedance.
6) Set the NORM/REV switch to NORM.
7) Connect the first line under test to the NORM SEND 310 jack or 5-way binding posts.
8) Connect the Model 43-01 chassis ground post ⏚ to the local ground or the sleeve (shield) of either 2W line undergoing test.
9) Connect the lineman's handset to the DIAL/TALK 310 jack.
10) Depress the off-hook button or turn on the off-hook switch on the lineman's handset.
11) Listen for the dial tone from the handset, then proceed to dial the desired number.
12) When the call is answered, set the HOLD/OFF switch to the HOLD position.
13) Connect the second line under test to the NORM RCV 310 jack or 5-way binding posts.
14) Set the NORM/REV switch to REV. The lineman's handset is now connected to the NORM RCV jack.
15) Verify that a dial tone is present in the lineman's handset when the off-hook button is depressed.
16) Dial the second desired number.
17) When the calling party answers, set the DIAL-TALK/MEAS switch to MEAS in order to place both lines in the normal test mode of operation.
18) The lineman's handset is now disconnected from both lines and can be unplugged or left plugged into the DIAL/TALK 310 jack without affecting tests or measurements.

Note: To redial because of any error or a busy line during any of the previous procedures, simply momentarily release or switch off the off-hook switch on the lineman's handset. Then redial the desired number as previously discussed.

4.12 Supervisory talk/listen functions can interrupt normal measurements at any time by reconnecting the lineman's handset to the DIAL/TALK 310 jack and setting the DIAL-TALK/MEAS switch to the DIAL/TALK position. To access the right-hand jacks, set the NORM/REV switch to the NORM position and to access the left-hand jacks, set the NORM/REV switch to the REV position. Normal measurement operation can be restored by setting the DIAL-TALK/MEAS switch to MEAS, as long as the HOLD/OFF switch is left in the HOLD position.

The lineman's handset can be used as a private monitor of the signal being measured by the Model 43-01 by connecting the lineman's handset to the DIAL/TALK 310 jack and setting the 2W/4W switch to the 4W position. To avoid local sidetones and acoustical noise pick-up, set the lineman's handset off-hook switch to the on-hook position. This is a convenience when the sound from the Model 43-01 monitor may be objectionable to others in the vicinity or when privacy is desired. Using this method, the lineman's handset monitors the selected receive pair with a nominal fixed gain of 0 dB.

G. 2W Answer

4.13 The Model 43-01 can answer an incoming call in two different ways. The first method uses the facilities provided by the Model 43-01, whereas the second method uses a lineman's handset or equivalent external facility. The first method can be used only where one 2-wire line is being answered. If two 2-wire lines are to be answered, it is necessary to use the second method.

4.14 First Method

Set the Model 43-01 switches to the following configuration:

1) BRIDGE/TERM to BRIDGE.
2) HOLD/OFF to OFF.
3) Connect the incoming 2-wire line to the NORM RCV 310 jack or 5-way binding posts.
4) Set DIAL-TALK/MEAS to MEAS.
5) Set the measure function switch to LEVEL.
6) Turn on the MONITOR volume.
7) Set the 135 Ω/900 Ω/600 Ω switch to match the line impedance.
8) Listen for the incoming ring. When the ringing signal is heard, turn the HOLD/OFF switch to the HOLD position. The line is now answered.
9) Set BRIDGE/TERM to the desired position (see paragraph 4.04).
10) Set NORM/REV to NORM to receive on a 2-wire line. Set NORM/REV to REV to send on a 2-wire line.

4.15 Second Method

To perform this method, a lineman's handset is required. Perform the following procedure:

1) Set HOLD/OFF to OFF.
2) Select DIAL-TALK/MEAS to DIAL/TALK.
3) Set 2W/4W to 2W.
4) Set BRIDGE/TERM to BRIDGE.
5) Connect the 2-wire lines to be answered to the NORM SEND and the NORM RCV 310 jacks.
6) Set the 135 Ω/900 Ω/600 Ω switch to match the line impedance.
7) Connect the lineman's handset to the DIAL/TALK 310 jack. Make sure the lineman's handset switch is set to the on-hook position.
8) When an incoming call is identified, answer by setting the lineman's handset switch to the off-hook position.
9) Set the HOLD/OFF switch to HOLD.
10) If only one 2-wire line is being answered, go to the normal measurement mode by setting the DIAL-TALK/MEAS switch to the MEAS position.
11) If a second 2-wire line is to be answered, set NORM/REV to REV and leave the DIAL-TALK/MEAS switch in the DIAL/TALK position.
12) Set the lineman's handset switch to the on-hook position.
13) When an incoming call is identified, answer it by setting the lineman's handset switch to the off-hook position.
14) To go to the normal measurement mode of operation, set the DIAL-TALK/MEAS switch to the MEAS position.
15) Select BRIDGE or TERM as desired for the receive 2-wire line (see paragraph 4.04).
16) Select send or receive by setting the NORM/REV switch to the appropriate position. (See paragraph 4.05).

4.16 After going to the normal measurement mode of operation, the lineman's handset may be left connected to the Model 43-01 and be used as a monitor for the receive signal by setting the 2W/4W switch to 4W.

5. RECEIVE LEVEL AND FREQUENCY MEASUREMENT

5.01 This section describes the operating procedure for the Model 43-01 when performing receive level and frequency measurements.

5.02 Overrange and underange condition indicators are provided to alert the operator when the level and/or frequency of the signal being measured exceeds the measurement capacities of the Model 43-01. Refer to Figure 6 while performing the procedures in this section.

A. Measurement

5.03 To perform a receive level and frequency measurement, proceed as follows:

1) Perform the required line interface procedures in Section 4.
2) Set the measure function knob to the LEVEL position.
3) The left-hand display will indicate the receive level in dBm referenced to the selected terminating impedance.
4) The right-hand display will indicate the received frequency in kHz. The right-hand display will have a maximum frequency reading capability of 19.999 kHz when the GENERATOR knob is set to the VF (4), .403, 1.004, or 2.809 positions. The frequency counter will read up to 199.99 kHz when the GENERATOR knob is set to the WB (120) or the PROG (20) positions.

B. Overrange and Underrange Indications

5.04 If the receive signal exceeds the measurement capacities of the Model 43-01, one of the following overrange or underrange indications will occur:

1) If the level goes above +10 dBm, the left-hand display will blank with the exception of the positive sign indicating that level overrange condition exists.
2) If the level goes below -90 dBm, the left-hand display will blank with the exception of a negative sign, indicating that a level underrange condition exists.

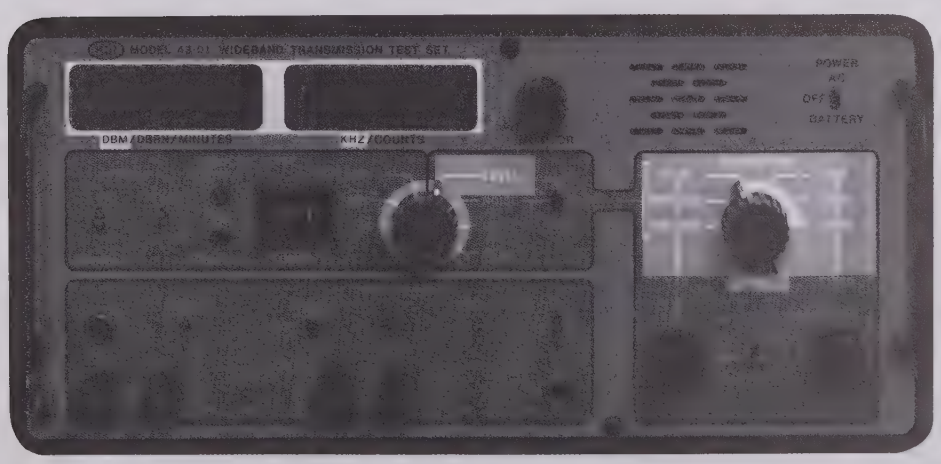


Figure 6. Receive Level and Frequency Measurements

3) If the received frequency is above 19.99 kHz when the GENERATOR knob is in the VF (4), .403, 1.004 or 2.809 positions or above 199.99 kHz when the GENERATOR knob is in the WB (120) or PROG (20) positions the righthand display will blank with the exception of a positive sign.
4) If the received frequency is below the measurement capability of the Model 43-01 the right-hand display will indicate all zeros.

6. NOISE MEASUREMENT

6.01 This section describes the operating procedure for the Model 43-01 when performing noise measurements. The user can make the following noise-weighted filter measurements:

1) C-message with or without tone.
2) 3 kHz flat with or without tone.
3) Program with or without tone.
4) 15 kHz flat with or without tone.
5) 50 kBit (497 F) with or without tone
6) 50 kHz flat with or without tone.

Refer to Figure 7 while performing the procedures in this section.

A. Measurement

6.02 To perform a noise measurement, proceed as follows:

1) Perform the line interface procedures given in Section 4.
2) Set the measure function knob to NOISE (W/T) to measure the noise on channels having a holding tone. If a holding tone is not on the channel, set the measure function knob to the NOISE (WO/T) position.
3) Set the WGTD/FLAT switch to the WGTD position if C-message, program or 50 kBit (497 F) filter weighting is required. Set the WGTD/FLAT switch to the FLAT position if 3 kHz flat, 15 kHz flat, or 50 kHz flat filter weighting is desired.
4) Set the GENERATOR knob to the VF (4) position for C-message or 3 kHz flat weighting. Set the GENERATOR knob to PROG (20) for program or 15 kHz flat weighting. Set the GENERATOR knob to the WB (120) position for 50 kBit (497F) and 50 kHz flat weighting.

Note: With the GENERATOR knob set to the .403, 1.004 or 2.809 positions the C-message or 3 kHz flat weighting filters are selected depending upon the position of the WGTD/FLAT switch.

5) The left-hand display will indicate the received noise expressed in dBrn.

6.03 The right-hand display will be blank during noise measurements.

6.04 The user can determine the signal-to-noise ratio of a channel with holding tone by first measuring the circuit noise with the measure function knob set to the NOISE

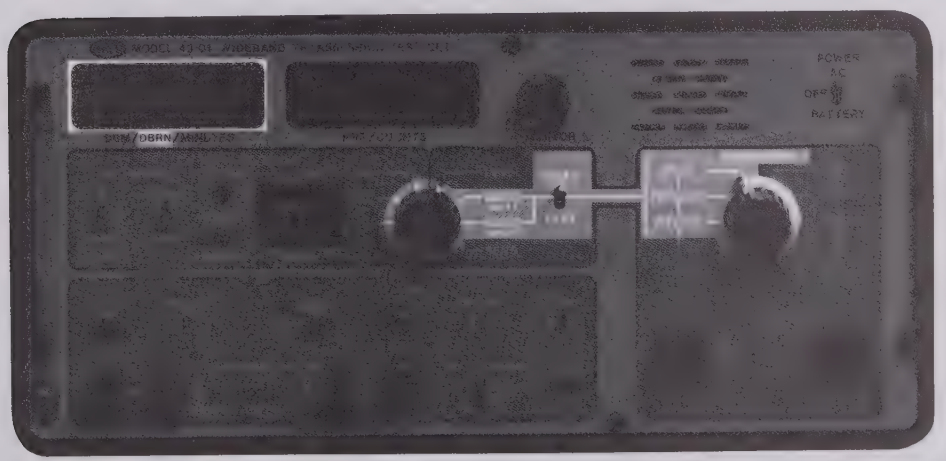


Figure 7. Noise Measurement

(WO/T) position, and then measuring the circuit noise with the measure function knob in the NOISE (W/T) position. By subtracting the second reading from the first, the user can determine the signal-to-noise ratio of the channel.

B. Overrange and Underrange Indications

6.05 If the received noise goes above +100 dBrn, the left - hand display will blank with the exception of the positive sign indicating that an overrange condition exists.

6.06 If the received noise goes below 0 dBrn, the left - hand display will blank with the exception of the negative sign indicating that an underrange condition exists.

7. IMPULSE NOISE MEASUREMENT

7.01 This section discusses the operating procedures for the Model 43-01 when performing impulse noise measurements. Refer to Figure 8 while performing the procedures in this section.

WARNING: Do not change any front panel switch settings once the impulse noise measurement is started. Doing so may cause invalid data to be recorded.

7.02 To perform impulse noise measurements, proceed as follows:

1) Perform line interface procedures given in Section 4.
2) Set the DBRN thumbwheel switches to the desired low threshold level.

Note: Threshold spread between LOW and MID and MID and HI is preset to 4 dB.

3) Set the TIMER MINUTES switch to 5, 15, or CONT as desired.
4) Set the WGTD/FLAT switch to WGTD for C-message, Program, 50 kBIT (497 F) filter weighting. Set the WGTD/FLAT switch to FLAT for 3 kHz flat, 15 kHz flat, or 50 kHz flat filter weighting.
5) Set the GENERATOR knob to VF (4) for C-message or 3 kHz flat. Set the GENERATOR knob to PROG (20) for Program, or 15 kHz flat. Set the GENERATOR knob to WB (120) for 50 kBit (497F) or 50 kHz flat filter weighting.

Note: With the GENERATOR knob set to the .403, 1.004 or 2.809 positions the C-message or 3 kHz flat weighting filters are selected depending upon the position of the WGTD/FLAT switch.

6) Momentarily press the TIMER START/STOP switch to the START position.
7) The left-hand display will indicate the elapsed time in minutes that the impulse noise measurement has been in-process.
8) By setting the measure function knob to the LOW, MID, and HI positions, the right-hand display will indicate the accummulated low, mid, and high impulse noise counts, respectively.

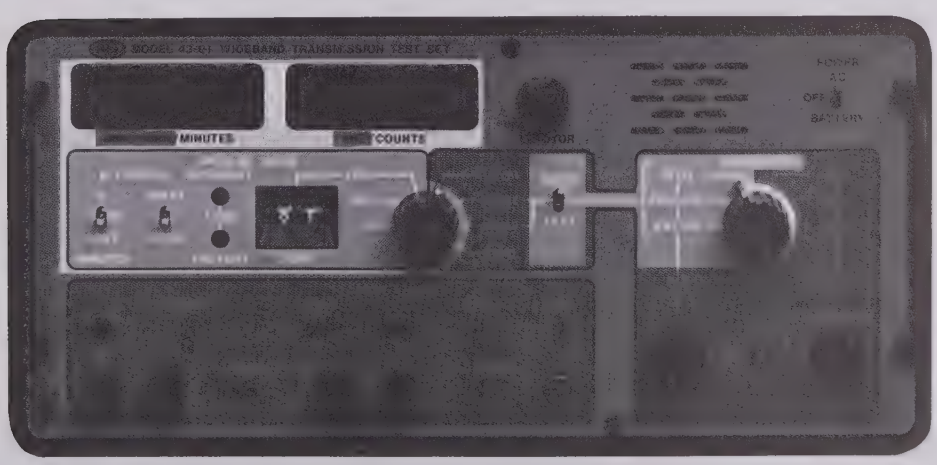


Figure 8. Impulse Noise Measurement

7.03 The TONE PRESENT indicator will be lit whenever a valid holding tone is present. If for any reason, the holding tone is lost during impulse noise measurements, the TONE INTERRUPT indicator will light and remain lit until the impulse noise measurement is started again.

7.04 The user can monitor the receive level and frequency without affecting the impulse noise measurement by setting the measure function switch to the LEVEL position.

8. SEND LEVEL AND FREQUENCY SETUP

8.01 This section describes the send level and frequency setup procedures for the Model 43-01. Refer to Figure 9 while performing the procedures in this section.

8.02 In order to set up the send level, proceed as follows:

1) Perform the line interface procedures in Section 4.
2) Set the measure function knob to SEND.
3) Set the LEVEL VAR/−16DBM/QUIET switch to the VAR position for a variable level adjustment, to −16DBM for fixed −16 dBm output level, or to QUIET for quiet termination on a send line.
4) If the LEVEL VAR/−16 DBM/QUIET switch is set to the VAR position, adjust the LEVEL VAR knob for the desired send level as indicated in the left-hand display of the Model 43-01.

8.03 Perform the following steps for the send frequency setup:

1) Set the GENERATOR knob to the WB (120) position for a variable generator from 1250 Hz to 120 kHz. Set the GENERATOR knob to PROG (20) for a variable generator from 250 Hz to 24 kHz. Set the GENERATOR knob to the VF (4) position for a variable generator from 50 Hz to 4.8 kHz. When the GENERATOR knob is in any of the three previous positions, the VAR knob is used to set the send frequency within the indicated ranges. The right-hand display will display the send frequency.
2) For fixed frequencies of 403, 1004, or 2809 Hz, set the GENERATOR knob to the .403, 1.004 or 2.809 position, respectively.

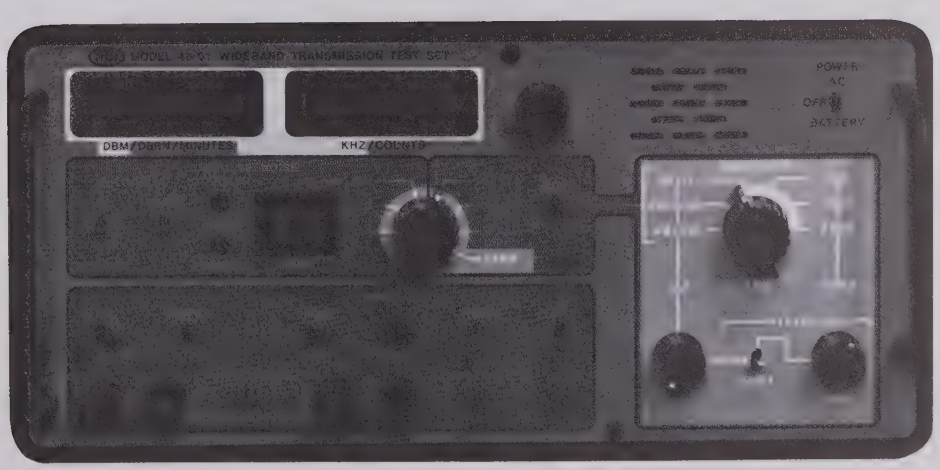


Figure 9. Send Level and Frequency Setup

9. MONITOR

9.01 This section describes the operation of the Model 43-01 audio monitor. Refer to Figure 10.

9.02 The Model 43-01 MONITOR provides automatic gain control (AGC) when the measure function knob is in the LEVEL, NOISE (W/T), NOISE (WO/T) or SEND position. A fixed gain, determined by the DBRN thumbwheel setting, is provided when the measure function knob is in the LOW, MID or HI position.

Since up to 90 dB of AGC is provided, the noise background will change dramatically when the measure function knob is in the LEVEL, NOISE (W/T), NOISE (WO/T) or the SEND position.

Any user-selected filter weighting can be applied to the monitor signal. In the case when the measure function knob is set to the NOISE (WO/T) position, the user can monitor any of the noise weighting filter signals without the notch in-line.

When the measure function knob is set to the LOW, MID, HI or NOISE (W/T) position, the signal being monitored is the selected noise weighting filter plus the notch which removes any 1 kHz test tone that may be present. This provides the user with the ability to listen to the notched output with fixed gain when in the LOW, MID or HI modes or with a notched AGC'd output in the NOISE (W/T) mode as desired. This is particularly useful in trouble-shooting certain types of noise and crosstalk problems.

9.03 The volume of the monitor signal is controlled by the MONITOR knob. The user can turn the monitor off by setting this knob to the OFF position.

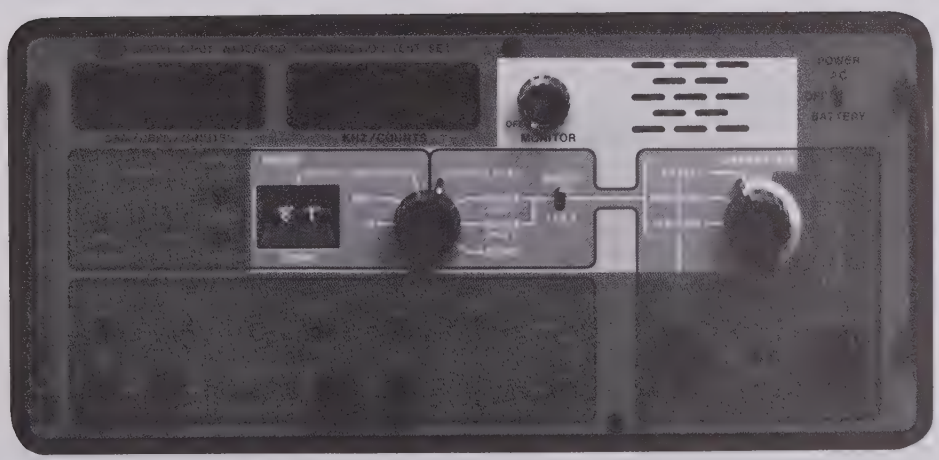


Figure 10. Monitor

10. SELF-TEST

10.01 This section describes the procedure for self-testing the Model 43-01. These procedures are to be used for self-test purposes only, and are not intended for calibration. A looping cord is required to do the self-test. Perform the following self-test procedures in sequence. Refer to Figure 11.

A. Initial Switch Settings

1) Connect the ac power cord to the rear panel receptacle and power source.
2) Connect the looping cord from the NORM REC jack to the NORM SEND jack.
3) Set BRIDGE/TERM to the TERM position.
4) Set HOLD/OFF to OFF.
5) Set DIAL-TALK/MEAS to MEAS.
6) Set the TIMER 5/15/CONT switch to the 5 position.
7) Set the DBRN thumbwheel switches to 76.
8) Set the measure function knob to SEND.
9) Set WGTD/FLAT to FLAT.
10) Set the GENERATOR knob to 1.004.
11) Set the LEVEL VAR/−16DBM/QUIET switch to −16DBM.
12) Set the POWER switch to the AC position.
13) Adjust the MONITOR knob for a comfortable listening level.

B. Generator, Level Meter and Frequency Counter Checks

1) With the initial switch settings completed the left-hand display should read -16.0 dBm ±0.1 dB and the right-hand display should read 1.004 kHz ±0.001 kHz.
2) Set the GENERATOR knob to 2.809. The left-hand display should read −16.0 dBm ±0.2 dB. The right hand display should read 2.809 kHz ±0.001 kHz.
3) Set the GENERATOR knob to .403. The left-hand display should read −16.0 dBm ±0.2 dB. The right-hand display should read 0.403 kHz ±0.001 kHz.
4) Set the GENERATOR knob to the VF (4) position.
5) Set the VAR knob fully counterclockwise.

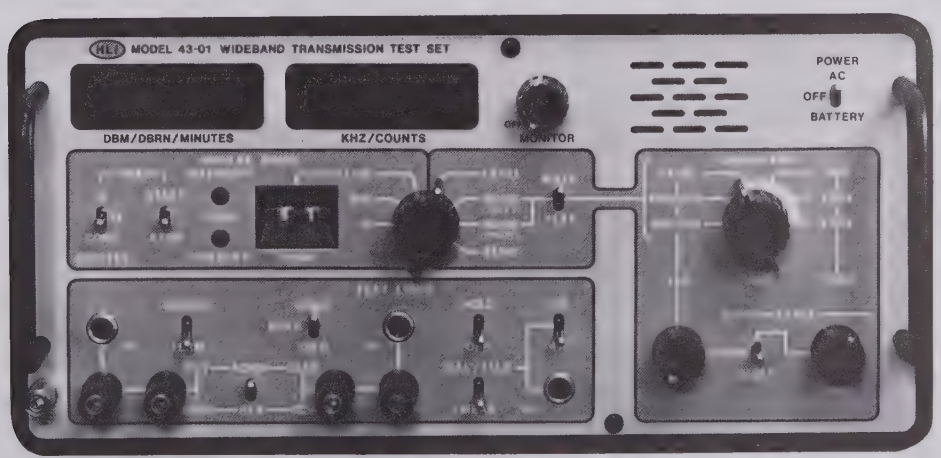


Figure 11. Self - Test

6) Slowly rotate the VAR knob clockwise. Verify that the left-hand display reads -16.0 dBm ±0.2 dB over the frequency range and the right-hand display goes from a minimum of 0.050 kHz or less to a maximum of at least 4.800 kHz.
7) Set the GENERATOR knob to the PROG (20) position.
8) Set the VAR knob fully counterclockwise.
9) Slowly rotate the VAR knob clockwise. Verify that the left-hand display reads -16.0 dBm ±0.5 dB over the frequency range. Also verify that the right-hand display goes from a minimum of 0.25 kHz or less to a maximum of at least 24.00 kHz.
10) Set the GENERATOR knob to the WB (120) position.
11) Set the VAR knob fully counterclockwise.
12) Slowly rotate the VAR knob clockwise. Verify that the left-hand display reads -16.0 dBm ±0.5 dB over the frequency range. The right hand display should go from a minimum of 1.25 kHz or less to a maximum of at least 120.00 kHz.
13) Set the GENERATOR knob to the 1.004 position.
14) Set the LEVEL VAR/-16 DBM/QUIET switch to the QUIET position. Verify that the left-hand display blanks with the exception of a negative sign and the right-hand display reads all zeroes.
15) Set the LEVEL VAR/-16 DBM/QUIET switch to the VAR position.
16) Set the LEVEL VAR knob fully counterclockwise. Verify that the left-hand display reads -40 dBm or less.
17) Slowly rotate the LEVEL VAR knob clockwise. Note that the left-hand display reading steadily increases to +10 dBm or more when the fully clockwise position is reached.
18) Set the LEVEL VAR/-16 DBM/QUIET switch to the -16 DBM position.
19) Set the measure function knob to the LEVEL position. Note that the left-hand display reads -16.0 dBm ±0.1 dB and the right-hand display reads 1.004 kHz.

C. Noise Meter and Filter Checks

1) Set the measure function knob to NOISE (WO/T).
2) Set the WGTD/FLAT switch to FLAT.
3) Set the GENERATOR knob to 1.004. Verify that the left-hand display reads 74 dBrn ±1 dB.
4) Set the GENERATOR knob to 2.809. Verify that the left-hand display reads 72 dBrn ±1 dB.
5) Set the WGTD/FLAT switch to WGTD Verify that the left-hand display reads 72 dBrn ±1 dB.
6) Set the GENERATOR knob to 1.004. Verify that the left-hand display reads 74 dBrn ±1 dB.
7) Set the GENERATOR knob to .403. Verify that the left-hand display reads 63 dBrn ±1 dB.
8) Set the GENERATOR knob to 1.004.
9) Set the measure function knob to NOISE (W/T). Note that the left-hand display reading is 24 dBrn or less.
10) Set the measure function knob to the SEND position.
11) Set the GENERATOR knob to PROG (20).
12) Adjust the VAR knob for a frequency reading of 0.40 kHz in the right-hand display.
13) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 65 dBrn ±2 dB.
14) Set the measure function knob to SEND.
15) Adjust the VAR knob for a frequency reading of 1.00 kHz in the right-hand display.
16) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 74 dBrn ±1 dB.
17) Set the measure function knob to SEND.
18) Adjust the VAR knob for a frequency reading of 10.00 kHz in the right-hand display.

19) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 66 dBrn ±4 dB.
20) Set the measure function knob to SEND.
21) Set the WGTD/FLAT switch to FLAT.
22) Adjust the VAR knob for a frequency reading of 15.00 kHz in the right-hand display.
23) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 71 dBrn ±1 dB.
24) Set the measure function knob to SEND.
25) Adjust the VAR knob for a frequency reading of 1.00 kHz in the right-hand display.
26) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 74 dBrn ±1 dB.
27) Set the measure function knob to SEND.
28) Set the GENERATOR knob to WB (120).
29) Adjust the VAR knob for 2.00 kHz.
30) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 74 dBrn ±1 dB.
31) Set the measure function switch to SEND.
32) Adjust the VAR knob for 50.00 kHz.
33) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 71 dBrn ±1 dB.
34) Set the measure function knob to SEND.
35) Set the WGTD/FLAT switch to WGTD.
36) Adjust the VAR knob for 1.25 kHz.
37) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 74 dBrn ±1 dB.
38) Set the measure function knob to SEND.
39) Adjust the VAR knob for 37.00 kHz.
40) Set the measure function knob to NOISE (WO/T). Verify that the left-hand display reads 68 dBrn ±2 dB.

D. Impulse Noise Check

1) Set the GENERATOR knob to 1.004.
2) Set the measure function switch to LOW.
3) Momentarily press START/STOP to the START position. Note the TONE PRESENT indicator is lit and the TONE INTERRUPT indicator is not lit.
4) Remove the looping cord and note that the TONE PRESENT indicator is not lit and the TONE INTERRUPT indicator is lit.
5) Reconnect the looping cord. Note that the TONE PRESENT indicator is lit and that the TONE INTERRUPT indicator remains lit.
6) Momentarily press START/STOP to the START position. Note that the TONE INTERRUPT indicator is not lit.
7) Set the GENERATOR knob to WB (120).
8) Set the WGTD/FLAT switch to FLAT.
9) Set the measure function switch to SEND.
10) Adjust the VAR knob for 2.00 kHz.
11) Momentarily press START/STOP to the START position.
12) Set the measure function switch to LOW, then MID and then HI. Note that the LOW counter is counting and the MID an HI counters are not counting.
13) Set the DBRN thumbwheel switches to 72.
14) Set the measure function switch to LOW, then MID and then HI. Note that the LOW and MID counters are counting and the HI counter is not counting.
15) Set the DBRN thumbwheel switches to 68.
16) Set the measure function switch to LOW, then MID and then HI. Note that the LOW, MID and HI counters are counting.
17) Set the DBRN thumbwheel switches to 60.

18) Momentarily press START/STOP to the START position.
19) After the TIMER times out at 5.0 minutes, use the measure function switch to read the LOW, MID and HI counts. Note they all read 2100 counts ±10%.

11. THEORY OF OPERATION

A. General

11.1 Input and output connection is made via WECO type 310 jacks and 5-way binding posts. This flexibility accommodates a 310 plug, standard dual banana plug, or a wire lead connection. When the 5-way binding posts are used, the sleeve (ground) connection is made to the ground (⏚) terminal. The 5-way binding posts are the same as the tip and ring connections on a 310 plug. The input and output connections are balanced. Both input and output have over voltage protection provided by spark gaps connected from tip-to-ground and ring-to-ground. The NORM/REV toggle switch reverses the roles of the send and receive connections, and facilitates bi-directional measurements while holding a 2-wire line.

11.2 Refer to Figure 12 for an overall block diagram of the Model 43-01.

B. Interface

11.3 Input Circuit: The input circuit consists of two polarized dc blocking capacitors, switch selectable terminating resistors of 600 Ω, 900 Ω, and 135 Ω, BRIDGE/TERM switch to disconnect all terminating resistors, and an input transformer. The transformer output feeds the input buffer (IC10) through a passive roofing filter and high frequency compensation network. The output of IC10 is gain normalized to 0.7746 V (0 dBm at 600 Ω) for 0 dBm input, regardless of the impedance selected. The input circuitry is located on the 4301-402 (I/O) circuit board with the exception of the terminating resistors and the front panel controls which are on the 4301-0-2-102 (INTERFACE) circuit board.

11.4 Output Circuit: The generator output level is a fixed +4 dBm and is connected to the fixed level attenuator and front panel level controls. The fixed or variable level is switch selected, normalized in send level at IC22, and adjusted for output impedance level at IC21. Both halves of IC21 act as a push-pull driver for the output transformer. The output transformer secondary is series connected for 600 Ω and 900 Ω, and parallel connected for 135 Ω. The transformer output is connected to the appropriate resistors for the selected output impedance. A pair of polarized capacitors provide dc blocking. The output circuit is located on the 4301-402 (I/O) circuit board, with the exception of the front panel controls and one of the impedance selection resistors which are on the 4301-0-2-102 (INTERFACE) circuit board.

11.5 Hold Circuits: The send and receive hold circuits are electrically identical and consist of a full wave rectifier and an electronic constant current load. Q3 (Q6) is the current carrying path, and Q1 (Q4) senses the voltage drop across R131 (R136) to regulate the input current to Q2 and Q3 (Q5 and Q6), which are connected as a Darlington amplifier. R129 (R134) will shunt currents of Q2 (Q5) away from Q3 (Q6) to prevent unwanted conduction in Q3 (Q6). Both hold circuits are located on the 4301-402 (I/O) circuit board and the front panel HOLD switch is on the 4301-0-2-102 (INTERFACE) circuit board.

11.6 Dial/Talk Circuit: The dial/talk circuit has two operating modes controlled by the 2W/4W (2-wire/4-wire) switch. In 2-wire dial/talk operation, the tip and ring connections of the send circuit are directly connected to the tip and ring of the headset jack. The send circuit electronic hold is bypassed for 2W dial/talk, so that the handset can control on-hook and off-hook conditions and dial out on the 2W line.

11.7 When the 4W dial/talk mode is selected, the handset tip and ring connections are connected to the primary side of the send transformer in place of the generator. The Model 43 provides internal talk battery to the handset. Communication can be established over the send line, but the handset cannot dial out. A receive circuit "leak" through R13 and C1 on the interface board permits the user to listen on the receive path and talk on the send path of a typical 4W system. When dial/talk is not selected, the handset remains connected

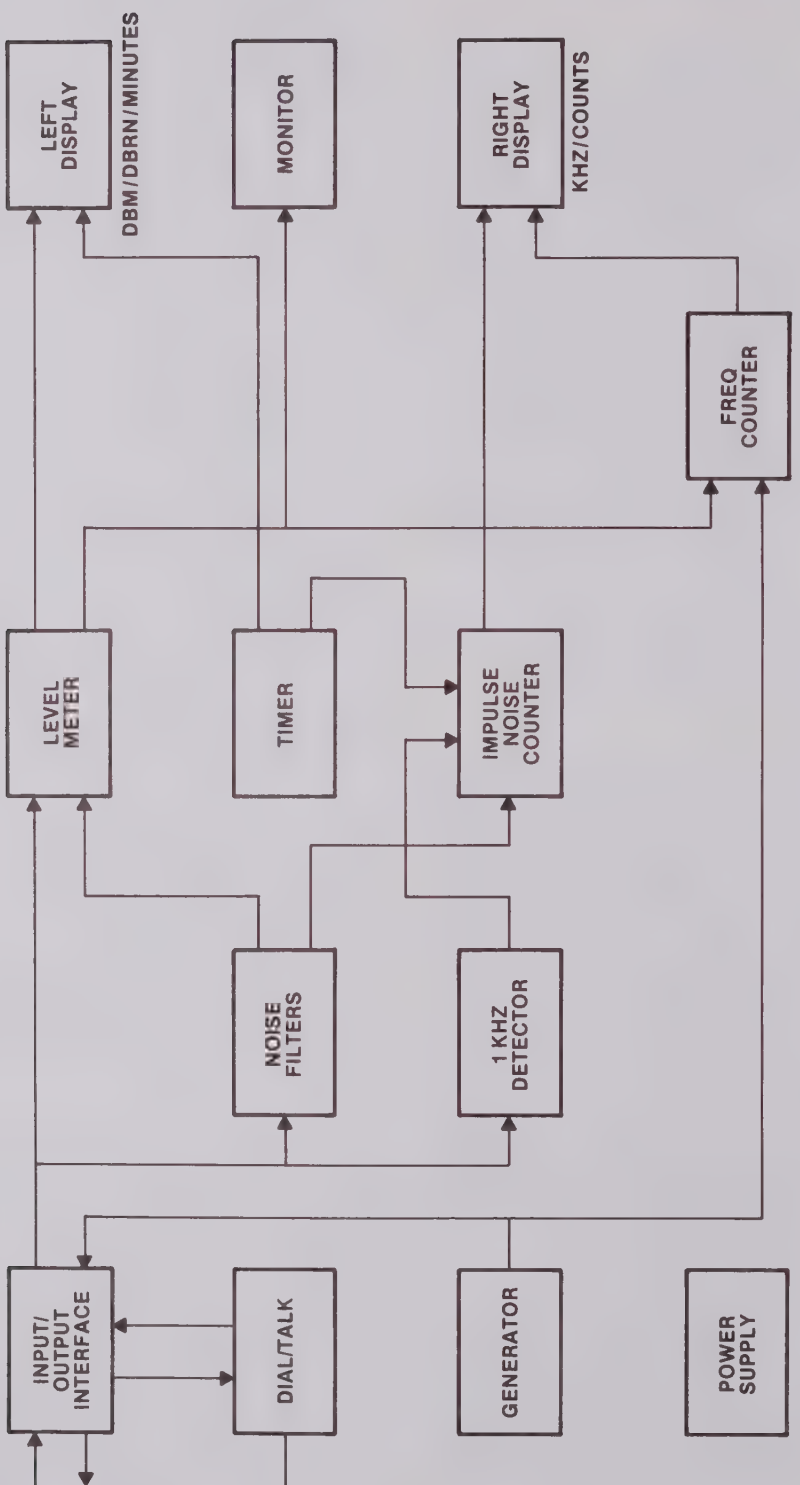


Figure 12. Model 43-01 Block Diagram

to talk battery and to the receive circuitry, so that the user may monitor the input through the handset when making measurements. This is useful when the monitor speaker disturbs others nearby.

C. Noise Filters

11.8 The noise filters include six noise weighting filters, a 1010 Hz notch filter, and electronic switching circuitry to select the desired noise filter. All noise filter circuitry is located on the 4301-402 (I/O) circuit board. All filter specifications conform to Bell PUB 41009 specifications.

D. Level Meter

11.9 Refer to Figure 13 for a block diagram of the level meter. The level meter consists of an autorange amplifier, detector, voltage reference, comparator and VCO, and up/down counter. The up/down counter steps the autorange amplifier up or down in 1 dB steps from 0 dB to 99 dB. The result is a log converter with wide dynamic range and extended high frequency response. The up/down counter also steps the voltage reference in 0.05 dB steps to complete the logarithmic measurement of the ac signal with 0.05 dB resolution. The resulting up/down counter state is digitally scaled to produce the correct level reading on the display.

11.10 Autorange Amplifier: The autorange amplifier consists of five amplifier stages controlled by the up/down counter. The −10/+30 dB stage provides either a gain of +30.0 dB or a loss of 10.0 dB, to provide a 40 dB step of gain when the input signal falls below −30.0 dBm. The 10 dB loss above −30.0 dBm adjusts the autorange amplifier to 0 dBm output at the maximum input level of +10.0 dBm. The −10/+30 dB stage uses IC14, IC17, IC23, and IC24 on the I/O board. The output of the −10/+30 dB stage feeds a 2-pole Butterworth low-pass filter with a corner frequency of 333 kHz to establish the noise bandwidth of the level meter.

11.11 The two 0/20 stages are basically the same as the 0/10 stage. Each is realized by a noninverting amplifier stage with 20 dB (or 10 dB) gain. To avoid gain errors due to the finite gain-bandwidth product of the amplifiers, the two 20 dB stages are bypassed when not required. The first 20 dB stage uses IC27 and part of IC28. The second 20 dB stage uses IC23 and part of IC28. IC15 performs the bypass function previously mentioned. IC16 and part of IC9 are used for the 10 dB stage. All amplifier stages except the −10/+30 dB stage are located on the 4301-302 (ANALOG) circuit board.

11.12 The 0 to 9 dB amplifier uses a noninverting amplifier stage with eight 1 dB steps. An additional step is accomplished by attenuating the input to IC14 by 8 dB in the steps 0 dB through 7 dB. When 8 dB gain is required, the gain of amplifier IC14 returns to 1 dB, but with an 8 dB high input signal. The remaining 1 dB step is accomplished in the same manner, with 1 dB of additional gain in IC14. The 0 to 9 dB amplifier uses IC14, IC8, and part of IC9.

11.13 Detector: A full-wave detector with two operating modes is used. For level measurements the detector configuration permits a full-wave average of the amplified input signal. For noise measurements the detector switches to a quasi-RMS mode. The detector uses IC19, IC6, and IC7 on the 4301-302 (ANALOG) circuit board.

11.14 Counter Control: The up/down counter control starts with a difference amplifier which subtracts the reference voltage from the detector output voltage and amplifies the resulting error voltage. The error voltage feeds both a comparator and a voltage controlled oscillator. The comparator determines the direction the counter will run, and the voltage controlled oscillator determines how fast the counter will count. As the error voltage approaches zero, the counter and the rate of change of the autorange steps slow down and eventually stop. This technique creates a true proportional control servo loop controlled by the reference voltage and the input signal. The counter control uses part of IC4 as the difference amplifier and part of IC2 as the comparator. The VCO is made up of IC1, and

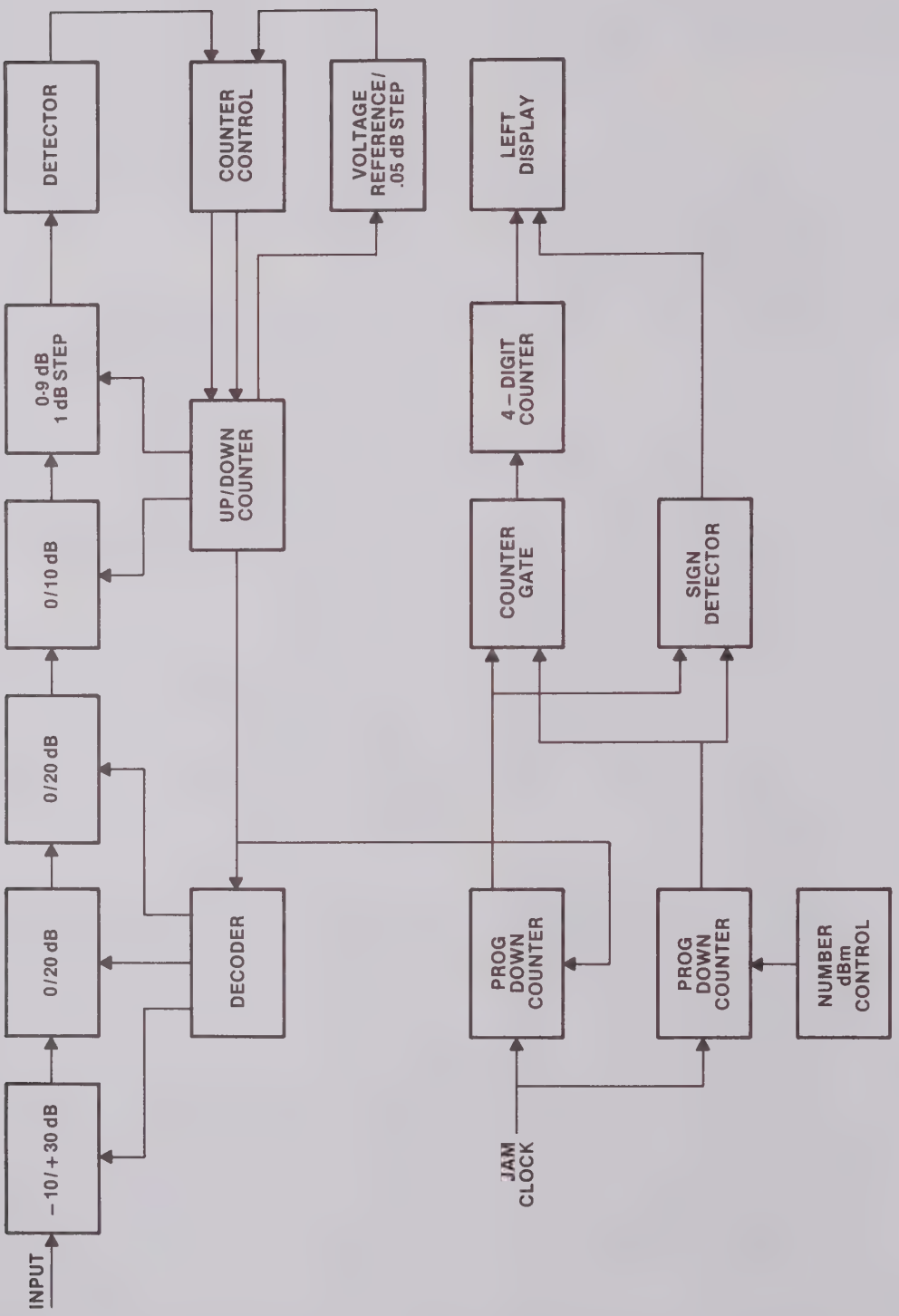


Figure 13. Level Meter Block Diagram

parts of IC2, IC5, and IC13. The counter control is located on the 4301-302 (ANALOG) board.

11.15 Voltage Reference and .05 dB Steps: The reference amplifier is a summing amplifier stage which adds .05 dB steps of voltage to the 6 V reference to control the difference amplifier. The .05 dB steps are controlled by the first two stages of the up/down counter and provide 0.05 dB resolution for the servo loop.

11.16 Up/Down Counter and Decoder: The up/down counter has a range from 0000 to 9995. Since the autorange amplifier is prescaled by 10 dB, 0000 corresponds to +10.0 dBm and 9995 corresponds to -89.95 dBm. The counter has 3 BCD stages and one binary stage. The binary stage controls the .05 dB half digit, and the 3 BCD stages count in .1, 1.0, and 10.0 dB steps. Anti-rollover protection is provided by part of IC13 to force the counter to stop when the high or low extreme is reached. The counter consists of IC20, IC32, IC33, and IC21. All up/down counter components are located on the 4301-302 (ANALOG) circuit board. The decoder is a digital logic circuit that converts the BCD code (1-2-4-8) to a 1-2-2-4 code to match the sequence of the autorange amplifiers.

11.17 Programmable Down Counters: The level meter utilizes two programmable down counters to scale the level output to a 0 dBm reference or a 0 dBrn reference. The first counter, IC35 on the analog board, receives four digits of information from the up/down counter. The second counter, IC1 on the digital board, receives four digits of preset information, which correspond to +10.00 dBm for level, or 100.0 dBrn for noise. The two presets correspond to the maximum reading in level or noise modes. The two programmable down counters start simultaneously and, through two OR gates and one exclusive OR gate, provide the logic signal whose pulse width is proportional to the displayed level.

11.18 Number Jam Logic: The number jam logic provides the two preset numbers for the programmable down counters plus a simultaneously reset signal so that both counters start at the same time. The number jam logic consists of IC21, IC22, and IC12 on the 4301-102 (DIGITAL) board.

11.19 In level mode the outputs of two programmable down counters are compared by a set/reset flip-flop at IC23. The last counter to remain counting determines the sign of the display. The sign detector is located on the 4301-102 (DIGITAL) board.

11.20 Counter Gate: The counter gate uses the pulse width proportional to level from IC22 to gate in 100 kHz clock pulses while active. The counter gate is IC14 and counting is controlled by IC3 and IC13 for timing. The rounding off algorithm is implemented by IC4. This adds .05 dB to the counts, and truncates the .01 dB digit to achieve a valid .05 dB rounded off to the next highest tenth of a dB. The counter gate is located on the 4301-102 (DIGITAL) board.

11.21 Level meter Counter: The level meter counter receives gate signals from the counter gate circuit and provides a multiplexed complementary BCD output to the display. The counter is IC39 on the 4301-102 (DIGITAL) board.

E. Timer

11.22 The timer consists of circuitry to display time, stop at predetermined intervals, and enable impulse counts. The four elements of the timer are the timer, display, counter, the 5/15 minute timer, and the switching transient detector. When the START switch is released, IC24 is enabled and divides the 10 Hz clock by a factor of 6 to 1-2/3 Hz. The 1-2/3 Hz clock signal corresponds to .01 minute and appears simultaneously at the 5/15 minute timer and the time display counter. Unless otherwise noted, all timer components are located on the 4301-102 (DIGITAL) board.

11.23 Time Display Counter: The time display counter, IC49, receives the 1-2/3 Hz clock pulse, (.01 minute) and counts up to 99.99 minutes before rolling over. Since only

tenths of minutes are required to be displayed, the counter digit selects are shifted one place to the right, so that the hundredths digit is the least significant digit and is blanked by logic circuits in the left display.

11.24 5/15 Minute Timer: The 5/15 minute timer consists of four decade counters and logic gates to initiate a stop pulse when 5 minutes or 15 minutes is selected by the front panel controls. There is also provision to select continuous operation, which disables the stop pulse. The start pulse comes from IC35 and IC34. The 4-decade counters are IC45 and IC55, and the logic gates consist of IC65, IC54, IC16 and IC17.

F. **Impulse Noise Counter**

11.25 The impulse noise counter receives an input signal from the output of the notch filter on the I/O board. The impulse noise counter consists of the impulse noise amplifier, the threshold comparators, and three 4-digit counters.

11.26 Impulse Noise Amplifier: The impulse noise amplifier has a gain range from 0 dB (99 dBrn on thumbwheel) to 59 dB (40 dBrn on thumbwheel). This programmed gain is the 9's complement of the threshold shown on thumbwheel switch. The amplifier consists of two 0/20 dB amplifier stages (IC30, IC31, IC25), one 0/10 dB amplifier stage (IC24, IC25), and one 0 to 9 dB amplifier stage with 1 dB steps (IC24, IC25, IC29). All amplifier components are located on the 4301-302 (ANALOG) board.

11.27 Threshold Comparators: The output of the impulse noise amplifier is connected to six comparators (IC17, IC18) configured for three positive threshold levels and three negative threshold levels. The positive and negative threshold comparators corresponding to one limit (LOW, MID, or HIGH) are wire-OR'd together into a 143 millisecond nonretriggerable one-shot. The 143 millisecond period provides the 7/second maximum counting rate. The reset of the one-shots is controlled by the inhibit line and inhibits impulse counts as determined by the timer or the 1 kHz tone detector. All threshold detector components are located on the 4301-320 (ANALOG) board.

11.28 4-Digit Impulse Counters: Three identical 4-digit counters accumulate the impulse counts detected by the threshold circuits, and are reset when the START switch is released. The counters operate in a continuous transfer mode, so that counts can be monitored while the test is in progress. The 4-digit counters are all located on the 4301-102 (DIGITAL) board, and are selected by the right display.

11.29 1 kHz Tone Detector: The 1 kHz tone detector receives the input signal on the I/O board, is filtered by a passive R-C bandpass filter and then amplified by IC18. At an input frequency of 1 kHz, the net gain to the output of R18 is 20 dB. The amplified signal is then fed to a limiter, IC18, on the analog board. The limiter has hysteresis and is biased in such a way that an input signal of less than –40 dBm does not activate it. The limiter output is then connected to the digital board, where IC53, IC54, IC43, IC33, IC34, and IC44 form a 1 kHz tone detector. Frequency counts from 960 Hz to 1030 Hz cause the TONE PRESENT indicator to turn on. If impulse noise-with-tone measurements are being made, loss of the holding tone inhibits the impulse noise counters for as long as the holding tone is lost. If there is no holding tone at the beginning of the impulse noise test, it is assumed that impulse noise-without-tone measurements are being made and the impulse noise test will be enabled until stopped by the 5/125 minute timer, or by the STOP switch.

11.30 Switching Transient Detector: The switching transient detector senses changes in the logic levels at the function switch and activates a 1/2 second one-shot. The one-shot inhibits the impulse noise counter when interfering instrument induced transients might be present. The detection of the transient is done with IC52, and IC43. The one-shot, IC35, controls IC6 to momentarily inhibit the impulse noise counter.

G. Frequency Counter

11.31 The frequency counter receives inputs from the autorange amplifier for receive frequency or from the generator board for send frequency. The frequency counter limiter is IC12 and part of IC18 on the analog board. IC12 is also used to double the input frequency for 1 Hz resolution measurements. For 10 Hz resolution the direct (not doubled) receive frequency directly feeds the counter. For send frequency measurement a signal that is 16 times the send frequency is received from the generator board. In the program and wideband modes, the generator board prescales by 10 so that the signal is 1.6 times the send frequency. For send frequencies the frequency counter uses an 80 Hz timebase instead of 50 Hz to scale the frequency correctly.

11.32 The frequency counter is a 4-digit LSI counter of the same type used for the level, time, and impulse displays, but has additional control logic. The frequency counter update rate is 1/second for 1 Hz resolution receive frequency measurements and 5/second for all other frequency measurements. The counter gate time is 500 ms for 1 Hz resolution receive frequency, 100 ms for 10 Hz resolution receive frequency, and 62.50 ms for all send frequency measurements. The frequency counter, IC26, is connected to the right display, and the control logic for timing is determined by IC41 and IC32. The frequency counter gate is IC52 and IC6. The half digit and overrange logic is IC19, IC20, IC30, and part of IC6. Selection of the correct update rate, signal input, and timebase is done at IC51 and IC61. All the above components are located on the 4301-102 (DIGITAL) board.

H. Displays

11.33 Left Display: The display receives the multiplexed complementary BCD from the level meter counter (IC39) or from the impulse noise timer (IC44). Selection of the desired signal is done with tri-state buffers (IC23, IC38, IC48, IC58). Leading zero blanking is detected by IC59 and IC18, and gated into the LSI display driver (IC72) by IC69, which also inverts the BCD. IC68 controls the digit selects to the LSI display driver using a strobe signal from IC25. The purpose of the strobe signal is to insure valid data on both edges of the digit select received by the LSI display driver. The display consists of four 0.3" high-efficiency red LED's with a segment current of approximately 3 mA. The displays are D1, D2, D3, and D4. All display components are located on the 4301-102 (DIGITAL) board.

11.34 Right Display: The right display receives the multiplexed complementary BCD signals from the frequency counter or impulse noise counters as selected by the front panel function switch. The outputs from the individual counters are selected with tri-state buffers (IC27, IC28, IC37, IC38, IC47, IC48, IC57, IC58). Leading zero blanking is detected by IC29 and IC18, and gated into the LSI display driver (IC71) with IC67, which also inverts the BCD information. IC66 inputs the digit selects to the LSI display driver using a universal strobe signal from IC25. The purpose of the strobe signal is to insure valid data on both edges of the digit select received by the LSI display driver. The display consists of four 0.3" high-efficiency red LED's with a segment current of approximately 3 mA. The displays are D5, D6, D7, D8, and D9. All display components are located on the 4301-102 (DIGITAL) board.

I. Monitor

11.35 The monitor circuit uses an audio amplifier IC located on the interface board plus a a speaker and volume control. The monitor input comes from the autorange amplifier in all level or noise measurement modes, and from the impulse noise amplifier in all impulse noise modes. The selection of input signal is done by IC3 on the ANALOG board. The monitor volume control has an off position which disconnects power to the monitor amplifier to conserve energy for battery operation.

J. Generator

11.36 Refer to Figure 14 for a detailed block diagram of the generator. All generator components are located on the 4301-202 (GENERATOR) board.

11.37 Crystal Oscillator: The crystal oscillator is an accurate and stable frequency source for the frequency counter timebase and the fixed frequencies selectable by the front panel GENERATOR switch. The oscillator frequency is 4 MHz, and is divided down to 1 MHz for the send timebase generator.

11.38 Divider Chain: The divider chain produces timing and clock signals required by the level meter, displays, and frequency counter. The divider chain uses IC7, IC17, IC15, and IC16.

11.39 Send Timebase Generator: The send timebase generator provides both timebase and clock input to the frequency counter for send frequency measurements. IC10 provides an 80 Hz timebase for the frequency counter gate since the send signal to the frequency counter is 16 times the output frequency in the VF band, and 1.6 times the output frequency for the program and wideband modes. The prescaling by 10 and mode switching is provided by IC23 and portions of IC17, IC18, and IC1.

11.40 Fixed Frequency Generator: The fixed frequency generator is a programmable divider with a total of six possible divide ratios. The three fixed frequency divide ratios are 620, 249, and 89 which provides 401.23, 1004.02, and 2808.99 Hz, respectively, at the output of the ordinate generator. The fixed frequency generator also provides divide ratios of 1, 5, and 25 for variable frequency operation, so that a single voltage controlled oscillator can be used for the three frequency bands. The fixed frequency generator uses IC3, IC12, IC1, and IC2.

11.41 Voltage Controlled Oscillator: The voltage controlled oscillator is an integrated circuit VCO with a discriminator stabilized loop to control frequency. The VCO signal from IC4 is converted to a logic pulse at IC5. The mean value of the logic pulse is integrated (IC19) with a dc reference voltage determined by the front panel frequency control to produce the desired output frequency. The design range of the VCO is from 16 kHz to 2 MHz, which provides bands of 50 Hz to 8 kHz, 200 Hz to 25 kHz, or 1000 Hz to 125 kHz, depending on the divide ratio selected in the fixed frequency generator.

11.42 Ordinate Generator: The ordinate generator uses an 8-state shift register connected as a Johnson counter. The shift register (IC14) receives synchronization signals from IC13 and IC6 and input clock from the fixed frequency generator. The shift register outputs are summed together with a resistor weighting network (R45 to R52). The output of the weighting network is a 16 ordinate sine wave, which is fed to the tracking filter.

11.43 Tracking Filter: The tracking filter consists of a two-section voltage variable low pass filter with an amplitude stabilized control loop. Each section of the low pass filter uses an OTA (operation transconductance amplifier) as the tuned element with a selected capacitance determined by the frequency band. The filter output is amplified and rectified by IC25. Half of IC19 provides the control loop integrator and additional carrier frequency filtering. The output of IC19 controls the bias current of the OTA's via Q3. The stabilized amplitude is adjusted for a level 6 dB below the ordinate generator input. This effectively sets each low pass filter to the −3 dB point. The amplitude stabilized signal is low pass filtered by IC27 and fed to the level control circuitry on the interface board.

K. Power Supply

11.44 The power supply provides the regulated dc voltages required by the Model 43-01 and the battery charger if the battery option is installed.

11.45 The power transformer has a dual primary which is wired in parallel for 115 V ac or series for 220 V. The transformer has two secondary windings. The 30 V CT winding is

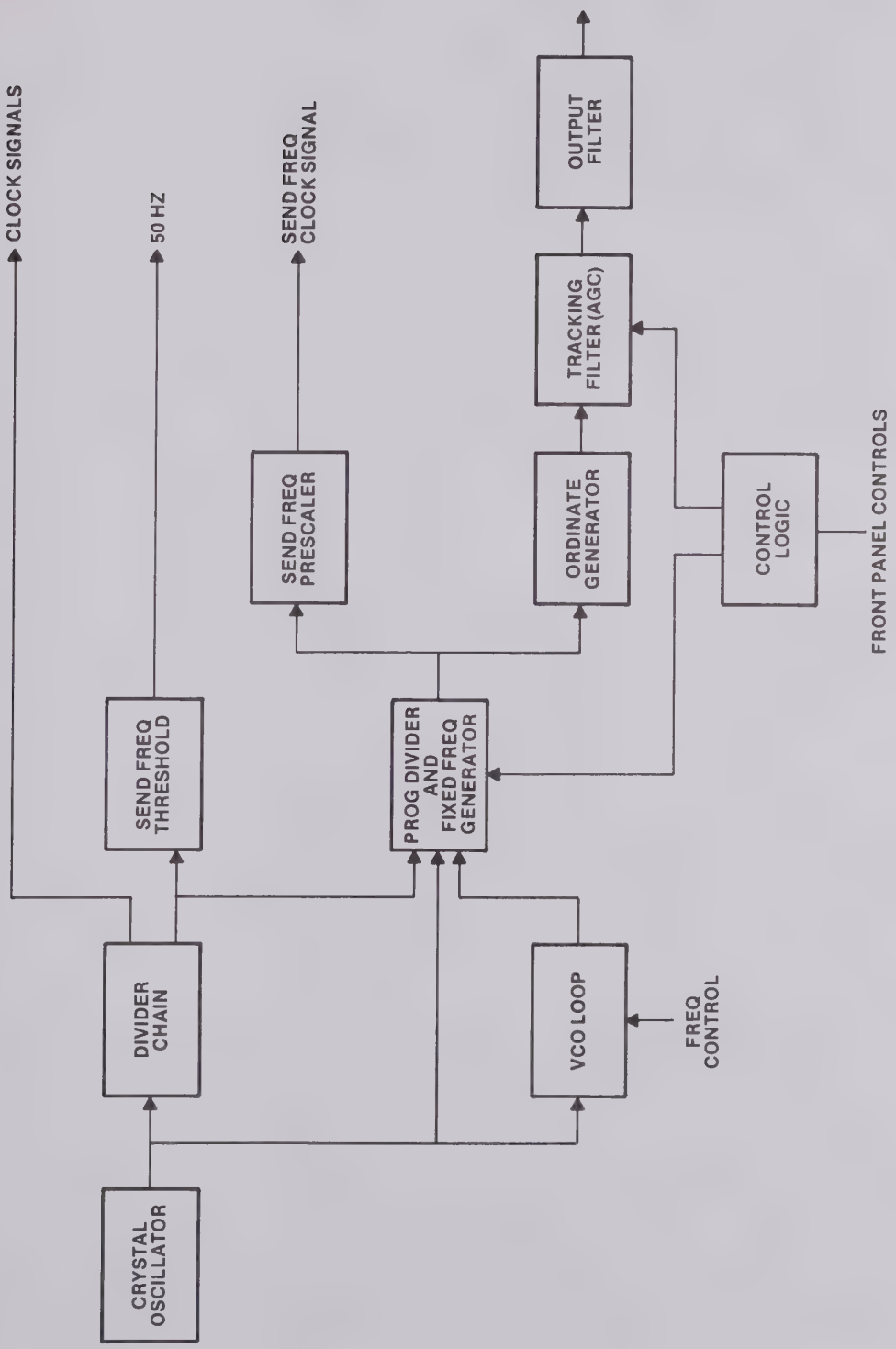


Figure 14. Generator Block Diagram

for the ±9 V supply and the two 9 V battery chargers, and the 10 V winding is for the 5 V supply and 5 V battery charger. The battery chargers are active whenever the unit is connected to the ac line. Battery charging can also be done simultaneously with ac operation. The battery charging current with the Model 43 off is nominally 120 mA, requiring 14-16 hours to charge a 1.2 AH battery pack for an estimated 4½ hours of battery life per charge.

12. CIRCUIT LEVEL TROUBLESHOOTING

A. General

12.1 The following sections describe the general procedures to be used in locating malfunctions. Where appropriate, performance standards, voltage levels, or waveform descriptions are provided to assist in the troubleshooting procedure. Unless otherwise stated, all voltage and frequency tolerances are ±10% and all dB tolerances are ±0.1 dB. When a circuit has the proper input signal, but the correct output cannot be measured, the components associated with that circuit should be checked and replaced if defective. Before detailed troubleshooting is undertaken, the power supply voltages should be checked. Low supply voltages may result from a malfunctioning power supply or excessive current being drawn by a defective circuit. A defective integrated circuit may often be located by feeling the case temperature. Normally, the integrated circuits are moderately warm to the touch. However, when defective, they can become extremely warm, causing a painful sensation when touched.

12.2 Accepted practices should be followed when repair is undertaken on mainframe components or the printed circuit boards. Recommended troubleshooting techniques are based on signal tracing methods where a known receive signal is used and the level and waveforms are verified as the signal progresses through the circuitry.

12.3 To gain access to the printed circuit board test and calibration points, refer to Section 14. Once the desired board is removed, insert the appropriate printed circuit extension board in the Model 43-01 slot.

B. Power Supply

12.4 The power supply provides outputs of +0.9 V dc ±0.2 V at XA-5 Pin 15, −9.0 V dc ±0.2 V at XA-5 Pin 12, and +5.00 V dc ±0.25 V at XA-5 Pin 10. The range of dc voltage at the regulator inputs is:

+18 to +23 V dc at D2 cathode
−18 to −23 V dc at D3 anode
+12 to +15 V dc at D5 cathode

12.5 The power transformer secondary should be 10 V ac from Pin 2 to Pin 3 (floating measurement) of J1 and 30 V ac from Pin 7 to Pin 8 of J1. All components and measurement points are located on the 4301-501 (POWER SUPPLY) board.

12.6 The battery pack is made of three independent nickel-cadmium batteries. Each 9 V battery (two used) has eight cells with a cutoff voltage (fully discharged point) of 8.8 V dc. At full charge the battery voltage can be as high as 11.0 V dc. The 5 V battery has four cells with a cutoff voltage of 4.4 V dc. At full charge the battery voltage can be as high as 5.5 V dc.

C. Generator

12.7 The generator board contains all generator components, and generator outputs include not only the sine wave output, but all timing signals used by the Model 43. A generator failure could appear to be a failure of some other circuit simply due to a lack of timing signal.

12.8 Crystal Oscillator: The crystal oscillator is a CMOS unbuffered gate oscillator circuit with a 4 MHz 32 pf parallel load crystal. When operating correctly IC9 Pin 12 will have a 0 V to 9 V square wave at 4.000 MHz ±0.005%.

12.9 Divider Chain: The divider chain has several stages. IC8 divides the 4 MHz by 4 to feed a 1 MHz clock to IC10 Pin 1, IC3 Pin 8, and IC7 Pin 2. IC7 is a dual ÷10 counter and provides a 100 kHz output for the level meter at Pin 6 and 10 kHz output for the multiplexed BCD on the digital board at Pin 14. IC15 and IC16 further divide the signal to provide 50 Hz, 10 Hz, 5 Hz, and 1 Hz clocks. The logic amplitude of all clock signals below 10 kHz is 5 V. IC8 and IC7 are run at +9 V and the 100 kHz and 10 kHz outputs are buffered and translated to 5 V logic by IC17.

12.10 Send Timebase Generator: IC10 receives the 1 MHz clock signal and divides down to 80 Hz at a 1 μs pulse width. The 9 V logic output at IC10 Pin 23 is buffered and translated to 5 V logic by IC17.

12.11 Fixed Frequency Generator: The input to IC2 Pin 9 is 4 MHz for 2809 and 1004 Hz, 1 MHz for 403 Hz, and the VCO output for the variable frequency modes. For the wideband tuning range IC2 is bypassed by IC1 Pin 11, Pin 12, and Pin 13. The programmable divider output at IC12 Pin 9 will be the following:

GENERATOR switch	Frequency
WB (120)	VCO (IC4 Pin 4)
PROG	VCO ÷ 5
VF	VCO ÷ 25
403	6451.61 Hz
1004	16064.26 Hz
2809	44943.82 Hz

12.12 Voltage Controlled Oscillator: The VCO output (IC4 Pin 4) is divided by two at IC6 Pin 13. IC5 is configured as a precision one-shot to provide one ¼ μs pulse for each positive edge of the signal at IC6 Pin 13. The output pulse at IC5 Pin 13 is a 6 V logic level. The integrator output (IC19 Pin 7) drives the VCO to the desired output frequency, which is the frequency at which the current in R1 is equal to the current in R2, less the offset adjustment current in R6.

12.13 Ordinate Generator: The ordinate generator input clock (Pin 9 of IC14) from the programmable divider is 16 times the desired output frequency and is a 9 V logic level. The ordinate generator stepped sinewave output is observable at the negative side of C48 at a level of +4 dBm.

12.14 Tracking Filter: The ordinate generator level drops to −43 dBm at IC26 Pin 3. The tracking filter normally tunes for an output level of +4 dBm at IC25 Pin 1. If this output is 6 dB high, then a problem with the capacitors or the relays controlling the capacitors should first be checked. The current in R73 is a maximum of approximately 1 mA at maximum output frequency on any range, and approximately 16 μA at lowest frequency on any range.

12.15 The signal at the anode of D3 is a half wave rectified sinewave. Full wave rectification is accomplished by summing the input signal through R66 with the half wave signal through R67 with twice the current. The output at IC19 Pin 1 is a negative dc voltage when the circuit is working correctly and should never be more negative than −6 V dc.

D. Interface

12.16 Output Circuit (I/O Board): An actual output level of 0 dBm into a 600 Ω load requires signal levels of +3.5 dBm at IC21 Pin 7 and IC21 Pin 1. The send level adjustments at IC21 Pin 1 are intended to trim the actual output level once the correct send level is established at IC22 Pin 6 (0 dBm for 0 dBm transmitted).

12.17 Input Circuit (I/O Board): The input circuit has unity gain to IC10 Pin 6 at a terminated 600 Ω impedance. Other impedances are normalized to 0.7746 V at 0 dBm at or before IC10. The high frequency response with 600 Ω impedance level is trimmed by C122 at 100 kHz for 0.1 dB maximum flatness error.

12.18 Hold Circuits: The hold circuits produce a holding current of 23 mA minimum at 46 V dc and a 40 mA maximum at 53 V dc, tested with a power supply which is current limited to 100 mA.

12.19 Dial/Talk Circuit: If the Model 43 is functioning normally except for the dial/talk function, then visually and electrically inspect the DIAL/TALK and 2W/4W switches.

E. Noise Filters

12.20 The following tables list nominal signal levels in dBm at various test points and were measured on a known good filter of the same type. A variation of more than 1 or 2 dB gives an indication of a defective component in that particular filter stage. The input level for all signals is −16 dBm. If the Model 43

under test has a known good generator and send circuit, then a loopback connection is satisfactory. Set the Model 43 to −16 dBm send level and set the function switch to SEND mode to monitor the test frequency. Since the output of the 15 kHz flat filter feeds the 3 kHz flat filter, the 15 kHz flat filter should be checked before the 3 kHz flat filter.

TABLE B. C-MSG FILTER CHECKS

FREQ. (Hz)	IC8-7 (dBm)	IC8-1 (dBm)	IC3-7 (dBm)	IC3-1 (dBm)
403	−17.9	−27.1	−26.9	−26.7
1004	−16.2	−17.9	−17.3	−16.1
2809	−16.0	−28.2	−21.5	−18.6

TABLE C. PROGRAM FILTER CHECKS

FREQ. (kHz)	IC11-7 (dBm)	IC11-1 (dBm)	IC6-1* (dBm)
0.4	−28.2	−28.3	−24.6
2	−14.9	−15.6	−11.4
10	−10.4	−26.8	−21.6

*Pin 7 on Rev B and later circuit boards

TABLE D. 50 kB FILTER (497 F) CHECKS

FREQ. (kHz)	IC19-7 (dBm)	IC19-1 (dBm)	IC15-7 (dBm)	IC15-1 (dBm)
0.050	−18.8	−18.8	−16.3	−18.7
1	−16.1	−16.0	−13.6	−16.0
45	−16.7	−25.0	−15.8	−27.5

TABLE E. 15 kHz FLAT FILTER CHECKS

FREQ. (kHz)	IC1-1 (dBm)
1	−16.0
15	−19.0
30	−18.3

TABLE F. 3 kHz FLAT FILTER CHECKS

FREQ. (kHz)	IC1-1 (dBm)
1	−16.0
3	−19.0
6	−28.3

12.21 To check the notch filter set the Model 43-01 filter switch to FLAT and the GENERATOR switch to PROG (20). The other noise filters should be checked first: Table G below lists the correct signal levels.

TABLE G. NOTCH FILTER CHECKS

FREQ. (Hz)	IC4-1 (dBm)
100	0.0 ±0.3 dB
403	0.0 +0.3, −1.5 dB
862	−1.5 ±1.0 dB
995	−50 max
1025	−50 max
1182	−1.5 ±1.0 dB
1700	−0.2 ±0.3 dB

F. Level Meter

12.22 Due to the servo loop operation of the level meter, troubleshooting of the level meter circuitry requires that each section be isolated and checked independently. The proper sequence of tests should be followed.

12.23 Detector Test: The detector circuitry can be tested by inputing a known signal and monitoring the detector outputs. Proceed as follows:

1) Disconnect the positive ends of C33 and C41 on ANALOG board, and inject 1 V RMS sine wave at 1 kHz.
2) The detector output voltage at IC4 Pin 5 should be approximately 1 V dc in both level and noise modes. This dc output voltage should be flat over the frequency range of 30 Hz to 100 kHz.
3) Remove the signals and reconnect C33 and C41.

12.24 Counter Control Test: The two outputs of the counter control circuit are up/down control to Pin 10 of each of the counters, and clock pulses to Pin 15 of each of the counters (IC21, IC33, IC32, IC20). With a voltage of between .6 and .7 V dc, the VCO should stop. When the voltage at IC4 Pin 5 is changed to −6 mV, the counters should start counting up; when the voltage at IC4 Pin 5 is changed to +6 mV, the counters should start counting down. A 6 mV change causes the VCO frequency to be about 100 Hz.

The circuit can be tested as indicated below:

1) Connect a short clip lead across C40.
2) Connect variable dc power supply to IC4 Pin 5.
3) Connect a dc voltmeter to IC4 Pin 7.
4) Adjust the dc power supply for a reading of 0 V dc. The voltage at IC4 Pin 5 should be approximately 0.6 to 0.7 V dc.
5) The gain of IC4 is 11.0 so that +0.1 V change at IC4 Pin 5 should produce a +1.1 V change in the output. To be sure that IC37 does not interfere, start with some positive voltage at IC4 Pin 7, then add +0.1 V change to the input and look for a 1.1 V change in the output.
6) The VCO sensitivity is approximately 1.5 kHz per volt, so that +2 V dc at IC4 Pin 7 produces a clock frequency at IC2 Pin 1 of 3 kHz ± 20%.
7) The hysteresis level of the up/down comparator at IC2 Pin 5 should be ±64 mV dc. When IC4 Pin 7 is at −1 V dc, IC2 Pin 5 should be positive.

12.25 Up/Down Counter Test: Test the up/down counter using the following procedure:

1) With the dc power supply at IC4 Pin 5, apply +1 V dc and observe that counter quickly counts down to all zeros. Examine all Q outputs of IC21, IC33, IC32, and IC20. The display should blank except for a plus (+) sign. Analog board Pin 18 should be +5 V dc ±1 V and Pin 17 should be 0.0 V dc ± 0.1 V.
2) Ground IC4 Pin 5, or apply a voltage of +0.3 V dc or less and observe that counter quickly counts to 99.95 and stops. Examine the Q outputs of the counters for:

	PIN 2	PIN 14	PIN 11	PIN 6
IC21	+9 V	0 V	0 V	+9 V
IC33	+9 V	0 V	0 V	+9 V
IC32	+9 V	0 V	0 V	+9 V
IC20	+9 V	+9 V	+9 V	+9 V

3) By carefully adjusting the dc power supply, it is possible to stop at any desired reading and test the ac gain stages. Refer to Table H.
4) Remove the clip lead from C40.

G. Impulse Noise Counter

12.26 If the level and noise-with-tone measuring functions are operating correctly, proceed with the following tests.

12.27 Impulse Noise Amplifier (ANALOG Board): With an input signal of 403 Hz, check the gain from XA-3 Pin S (P2 Pin S on ANALOG Board) to IC24 Pin 1. Refer to Table I.

12.28 Threshold Comparators (ANALOG Board): The output of the impulse amplifier (IC24 Pin 1) is coupled through an RC filter network to IC17 Pin 4, 6, 9, and 11 and IC18 Pins 4 and 11. The nominal threshold voltages are:

	PIN 5	PIN 7	PIN 8	PIN 10
IC17	+5.483	+3.460	−3.460	−5.483
IC18	+2.175	—	—	−2.195

12.29 The outputs of the comparators connect to one-shots IC10, and IC11. The pulse width from each one-shot is 143 milliseconds, active low at IC10 Pins 6 and 10, and IC11 Pin 6.

TABLE H. LEVEL METER GAINS STAGES

DISPLAY LEVEL MODE	−10/+30 (I/O BOARD)	0/+20 IC27	0/+20 IC23	0/+10 IC16	1 dB STEPS IC14
+0.1 to +9.9	−10	0	0	0	0
+9.1 to +8.9	−10	0	0	0	1
+7.1 to +7.9	−10	0	0	0	2
+6.1 to +6.9	−10	0	0	0	3
+5.1 to +5.9	−10	0	0	0	4
+4.1 to +4.9	−10	0	0	0	5
+3.1 to +3.9	−10	0	0	0	6
+2.1 to +2.9	−10	0	0	0	7
+1.1 to +1.9	−10	0	0	0	8
+0.1 to +0.9	−10	0	0	0	9
−0.1 to −0.9	−10	0	0	10	0
−10.1 to −10.9	−10	20	0	0	0
−20.1 to −20.9	−10	20	0	10	0
−30.1 to −30.9	+30	0	0	0	0
−40.1 to −40.9	+30	0	0	10	0
−50.1 to −50.9	+30	20	0	0	0
−60.1 to −60.9	+30	20	0	10	0
−70.1 to −70.9	+30	20	20	0	0
−80.1 to −80.9	+30	20	20	10	0

12.30 4-Digit Impulse Counters (Digital Board): IC36, IC46, and IC56 are the 4-digit counters. For any suspected counter, establish continuous counts at the input (Pin 7) and check Pin 9 for 5 V 1000 Hz square wave and Pin 6 for a high logic level. Then observe the outputs to verify that counts are accumulating. Replace counter if defective.

12.31 Switching Transient Detector: IC35 Pin 11 is normally high, with a momentary low when each function switch position is selected. The output at IC35 Pin 10 is a positive pulse for ½ second whenever Pin 11 goes low. If the input at IC35 Pin 11 does not go low, then IC43, IC32, and IC52 should be checked. If the impulse test is in progress, the high level at IC6 Pin 11 should be interrupted by the ½ second interval when the function switch changes positions. If this condition is not obtained, check Pins 11, 12, and 13 of IC6. Verify that the level at IC44 Pin 4 is high when the timer is running. (If test was started with holding tone present and the holding tone is gone, then IC44 Pin 4 will stay low until the holding tone returns.)

TABLE I. IMPULSE NOISE GAIN

Threshold (dBrn)	Gain (dB)	Likely Failure If Negative Result
99	9	IC24
98	1	IC24, IC29
97	2	IC29
96	3	IC29
95	4	IC29
94	5	IC29
93	6	IC29
92	7	IC29
91	8	IC25
90	9	IC25
80	19	IC24, IC25
70	29	IC31, IC30
60	39	IC25
50	49	IC31, IC30
40	59	IC31

12.32 1 kHz Tone Detector: The level at IC18 (I/O Board) Pin 5 is 10 dB lower than the input signal level at a frequency of 1000 Hz. The overall gain from IC10 Pin 6 to IC18 Pin 5 is 20 dB at 1 kHz. With −16 dBm input at 1004 Hz, IC18 Pin 7 should be +4 dBm ± 1 dB. If this signal level is present, check the analog board. The limiter output (IC18 Pin 1, ANALOG Board) should be a +5, −9 V square wave at 1004 Hz. The square wave should stop when the input level is reduced to −40 dBm ± 2 dB.

12.33 All remaining circuitry, except for the LED and driver, is on the DIGITAL Board. If the 1004 Hz square wave is present at IC53 Pin 1, check XA-1 Pin 4 for a 5 V logic level. If Pin 4 is high, the green LED (TONE PRESENT) must be on. If not, check LED and driver transistor on the INTERFACE Board. If Pin 4 is low, check the following:

1) 4 Hz square wave at IC53 Pins 7 and 15.
2) 5 V logic level at IC53 Pin 2.
3) Presence of counter outputs at IC53 Pins 6, 12, and 13.
4) Logic pulse at 5 Hz rate at IC54 Pin 10 and high for approximately 44 ms. If no pulse is present, IC33 is probably defective.

12.34 Tone Interrupt LED: If the TONE INTERRUPT is the only nonfunctional indicator, check for 5 V logic level at XA-1 Pin 3 on the INTERFACE Board. The TONE INTERRUPT LED should be on if the function switch is in one of the impulse noise positions and the START switch is pressed without 1 kHz present. If the logic level at XA-1 Pin 3 is 5 V but the indicator is not on, check the indicator LED D1 and driver transistor Q1 on the interface board. If the logic level is low, check IC44 and IC33 on the digital board.

H. Timer

12.35 Troubleshoot the timer with an oscilloscope to check for logic levels on the digital board. A low level is 0 V dc and a high level is +5 V dc. IC34 Pin 12 should be high after power-up and low after the START button is released. If IC34 Pin 12 is low, the timer should be running. Check for 1-2/3 Hz at IC24 Pin 1 and IC15 Pin 2. If absent, check for 10 Hz clock at IC24 Pin 14.

12.36 Time Display Counter: Check for the 1-2/3 Hz clock at IC49 Pin 7. Verify that Pin 6 is high, and the 1 kHz scan clock is present at Pin 9. If the preceeding measurements are correct, observe the outputs at IC49. If IC49 outputs are changing but the display is not, check the outputs of the tri-state buffer (Pin 1 of IC38 and IC58 must be low). If the display fails to indicate, refer to left display troubleshooting information.

12.37 5/15 Minute Timer: With 1-2/3 Hz present at IC45 Pin 10 (timer running), check outputs of counter chain: IC45 Pin 14, period of 0.6 second; IC45 Pin 6, period of 6 seconds; IC55 Pin 11, period of 12 seconds; IC55 Pins 13 and 14, period of 60 seconds; IC55 Pin 3, period of 120 seconds. If the preceeding are okay, then the individual gates of IC65 and Pins 3, 4, 5, and 6 of IC54 should be checked for correct logic function.

I. Frequency Counter

12.38 Verify that the level meter is functioning correctly. Apply an input signal of −16 dBm at 1 kHz and observe 0 dBm ± 1.5 dB signal at IC18 Pin 8 on the ANALOG Board. If this signal is present, IC12 Pin 3 should have a square wave at the same frequency, and IC12 Pin 10 should have narrow pulses at twice the input frequency. Both of these have a 5 V logic level.

12.39 The remaining circuitry for the frequency counter is on the DIGITAL Board which has 5 V logic unless otherwise noted. The frequency counter gate input is IC52 Pin 13. IC51 and IC61 select the desired counter input. The counter gate control signal is at IC52 Pin 12. A gated burst can be viewed at IC26 Pin 7; check IC6 and IC52. Set GENERATOR switch to WB and check counter IC26 for the following inputs:

1) Pin 9, 1000 Hz square wave
2) Pin 5, 5 Hz pulse rate, low for 20 milliseconds
3) Pin 6, 5 Hz pulse rate, low for 20 milliseconds

12.40 The outputs of IC26 should be indicating the correct frequency in multiplexed complementary BCD format.

J. Displays

12.41 Left Display: Check for 1-2-4-8 multiplexed BCD data at IC69 Pins 4, 10, 11, and 3. Use an oscilloscope with an external trigger connected to IC68 Pin 8. The BCD data observed should match the display. If not, check IC72 for the correct outputs. With a common anode display IC72 outputs are active low to light an individual LED segment. If the BCD data at IC69 outputs does not correspond to the desired counter output, check the tri-state buffers. Verify that buffers from the other counter are not active.

12.42 The leading zero blanking is detected by IC59. For each scan of the multiplexed BCD, the most significant digit initiates the blanking with a clock pulse to IC18. IC59 detects the presence of nonzero information and resets IC18. The correct input from IC69 to IC72 for blanking is all 5 V logic levels.

12.43 Right Display: Check for 1-2-4-8 multiplexed BCD data at IC67 Pin 3, 4, 10, and 11. Use an oscilloscope with an external trigger connected to IC66 Pin 8. The BCD data observed should match the display. If not, check IC71 for the correct outputs. With a common anode display IC71 outputs are active low to light an individual LED segment. If the BCD data at IC67 outputs does not correspond to the desired counter output, check the tri-state buffer (active low). Verify that buffers for the other counters are not active.

12.44 The leading zero blanking is detected by IC29. For each scan of the multiplexed BCD, the most significant digit initiates the blanking with a clockpulse to IC18. IC29 detects the presence of nonzero information and resets IC18. The correct input from IC67 to IC71 for blanking is all 5 V logic levels.

K. Monitor

12.45 Check for presence of input signal (0 to −6 dBm in LEVEL mode) at the monitor input XA-3 Pin Y on the interface board. If input signal is present, check for speaker continuity from Pin 3 to Pin 4 on the INTERFACE Board (cable harness connections) with an ohmmeter. If continuity exists and a small click is heard in the speaker, replace IC1.

13. CALIBRATION

A. General

13.1 The following procedures are used to recalibrate the Model 43. Recalibration is normally required when maintenance has been performed on associated circuitry or when there is reason to suspect that calibration is no longer accurate.

B. 6 V Reference (ANALOG Board):

1) Connect DMM common lead to XA-3 Pin W and "hot" lead to IC26 Pin 7.
2) Adjust R45 (near IC26) for a reading of −6.000 V dc ±0.001 V dc on the DMM.

C. Send Level Adjustment (I/O Board)

1) Set GENERATOR to 1004 Hz.
2) Connect ac voltmeter common lead to chassis and "hot" lead to IC22 Pin 6.
3) Adjust variable level for a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.
4) Remove the test leads.
5) Connect a precision (±0.1%) 600 Ω termination to the Model 43 output (do not use a loopback connection).
6) Connect the ac voltmeter across the send output terminals.
7) Adjust R114 (I/O Board) for a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.
8) Switch Model 43 to 900 Ω, and connect a precision (±0.1%) 900 Ω termination.
9) Adjust R115 (I/O Board) for a reading of +1.75 dBm ±0.05 dB on the ac voltmeter.
10) Switch Model 43 to 135 Ω, and connect a precision (±0.1%) 135 Ω termination.
11) Adjust R111 for a reading of −6.50 dBm ±0.05 dB on the ac voltmeter.

D. Generator Fixed Level (GENERATOR Board)

1) Connect the precision (0.1%) 600 Ω termination to the Model 43 output.
2) Switch the Model 43 to 600 Ω operation.
3) Set the LEVEL switch for fixed −16 dBm.
4) Adjust R69 on the generator board for a reading of −16.00 dBm ±0.05 dB on the ac voltmeter.

E. Low Frequency Limit (GENERATOR Board)

1) Set the Model 43 function switch to SEND mode and the GENERATOR switch to VF (4).
2) Set the variable frequency control fully counterclockwise.
3) Verify that the Model 43 frequency display indicates a frequency from 30 to 40 Hz. If outside this range, adjust R59 to 35 Hz ±2 Hz.

F. High Frequency Response (I/O Board)

1) Set the send frequency to 4 kHz ±10 Hz on the VF (4) kHz range.
2) Connect the Model 43 in a loopback, 600 Ω terminated configuration.
3) Connect the ac voltmeter to the receive terminals.
4) Adjust the send level for a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.
5) Move the ac voltmeter common lead to the chassis, and the "hot" lead to IC10 Pin 6.
6) Verify a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.
7) Reconnect the ac voltmeter to the receive terminals and switch the GENERATOR control to the WB (120) range.
8) Adjust the send frequency to 100 kHz ±2 kHz.
9) Note the ac voltmeter reading, then move the ac voltmeter to IC10 Pin 6.
10) Adjust C122 for the same reading on the ac voltmeter ±0.05 dB.

G. Receive Level Calibration (ANALOG Board)

1) Set up the Model 43 to measure receive level with a loopback 600 Ω terminated configuration with a fixed 1004 Hz output frequency.
2) Connect a DMM to the receive terminals.
3) Adjust the output level control for a reading of 0.7737 V ac to 0.7755 V ac (0.7746 V ac nominal) on the DMM.
4) Carefully disconnect the DMM and reconnect common lead to chassis and "hot" lead to IC2 Pin 6.
5) Set the DMM to the most sensitive dc voltage range.
6) Carefully adjust R113 for a reading of less than ±0.010 V dc on the DMM. The Model 43 should indicate a received level of 0.0 dBm.

H. C-MSG Filter Adjustment (I/O Board)

1) Set up the Model 43 to measure NOISE (WO/T)-WGTD with a 600 Ω terminated loopback configuration.
2) Adjust the output to 1 kHz at a level of 0.0 dBm (0.7737 V ac on DMM).
3) Connect the ac voltmeter common to chassis and "hot" lead to IC14 Pin 7.
4) Adjust R14 for a reading of 0.0 dBm ±0.1 dB on the ac voltmeter.

I. Notch Filter Alignment (I/O Board)

13.2 An ac voltmeter may be used at XA4 Pin 21 for null adjustments, but the Model 43 level display will be acceptable. When monitoring at XA4 Pin 21, connect the ac voltmeter common to XA4 Pin 22, and remember that at filter output levels below −30.0 dBm the gain to that point is 30 dB.

1) Set up the Model 43 in a 600 Ω terminated loopback configuration with a received level of 0.0 dBm ±0.2 dB at 1010 Hz (VF band).
2) Set the function switch to NOISE (W/T) and the filter switch to FLAT.
3) Connect short jumper from colored end of C30 to uncolored end of C31.
4) Adjust R30 and R159 for null.
5) Remove jumper from C30 and C31 and connect from colored end of C28 to uncolored end of C29.
6) Adjust R36 and R160 for null.
7) Remove jumper from C33 and C34 and connect from colored end of C30 and uncolored end of C31.
8) Adjust R43 and R161 for null.
9) Remove both jumpers.

14. BOARD INSTALLATION/ REMOVAL

14.01 This section describes the procedures for installation/removal of individual boards in the Model 43-01. Only the boards and assemblies described below are normally field serviced.

14.02 As shown in Figure 15, the Model 43-01 contains the following boards:

- Digital
- Generator
- Analog
- Input/Output (I/O)
- Power Supply

DANGER: Hazardous voltages exist inside this instrument. Disconnect power cord from unit before proceeding.

14.03 To remove and install individual boards in the Model 43-01, proceed as follows:

1) Remove the screws from the side and bottom of the Model 43-01. Refer to Figure 16.
2) Pull the case off the unit.
3) Disconnect the two Molex connectors from the Power Supply board. (Only if power supply board is to be removed).

WARNING: The Generator board must be removed before the Digital board can be removed.

4) Remove the Digital, Generator and Power Supply boards by pulling the boards from the rear of the unit.

WARNING: To avoid damaging the Analog and Input/Output boards, they must be removed together.

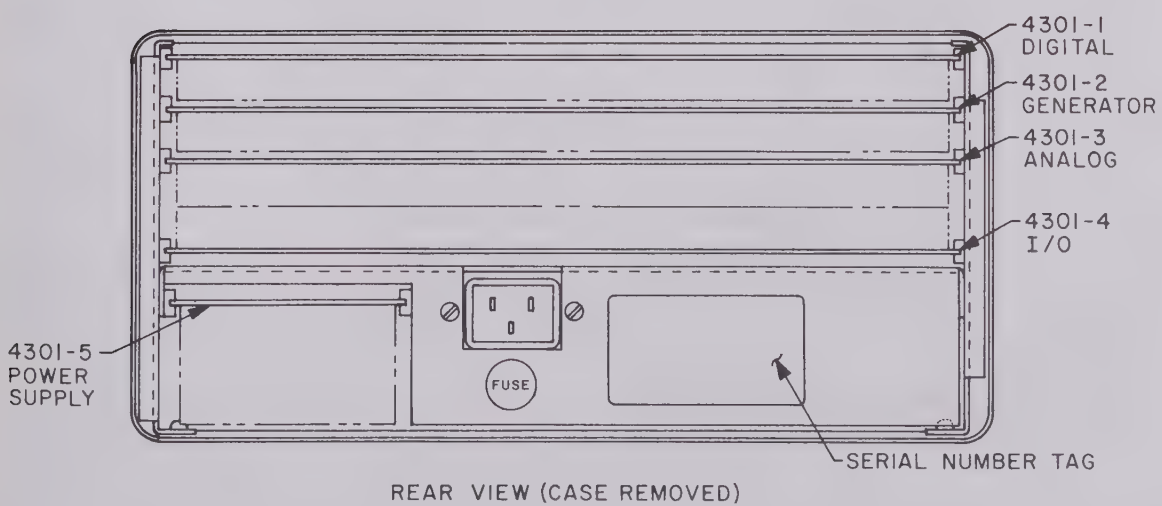


Figure 15. Model 43-01 PC Board Identification

5) Pull the Analog board toward the rear approximately ¼ inch.
6) Pull the Input/Output board toward the rear approximately ¼ inch.
7) Grasp both the Analog and Input/Output boards, and pull rearward until they both clear the unit.
8) To install the boards, reverse the removal procedure, and gently slide them into the Model 43-01 together until they are firmly seated in the edge connector.
9) Replace the Model 43-01 case.

14.04 For repair or servicing by HLI, refer to Section 15.

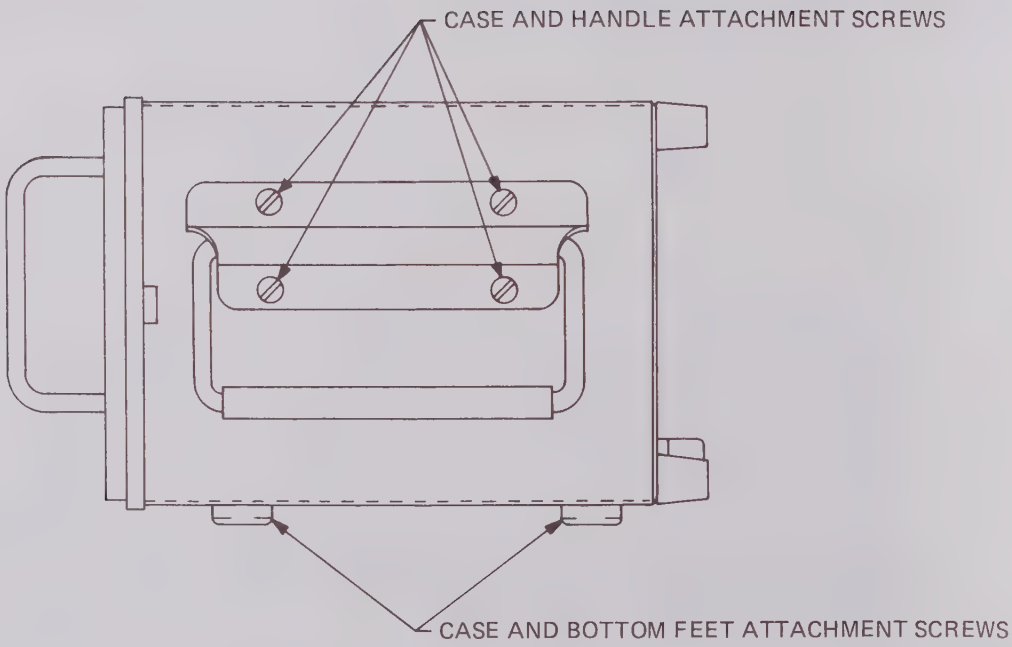


Figure 16. Assembly/Disassembly Screw Locations

15. PACKING, SHIPPING, AND RETURN TO FACTORY

15.01 This section contains procedures to be followed when returning the Model 43-01, or individual boards to the factory for repair or servicing.

Note: Most problems with the Model 43-01 can be isolated to the individual board level because of functional organization. It is recommended, therefore, that the factory be consulted by telephone or letter before shipping the unit.

A. Complete Unit

15.02 The original packing materials and shipping container for the Model 43-01 should be stored for use when shipment, between customer locations or return to factory, becomes necessary.

15.03 If the unit is being returned to HLI for repair or servicing, enclose the following information:

- Type of repair or service required
- Model number and serial number
- Return address
- Listing of symptoms if repair is required
- Name and telephone number of person to contact concerning the repair or service

Keep a copy of all information for yourself and refer to your copy in any correspondence with the factory.

15.04 If original packing materials and shipping container are unavailable, repack the unit as follows:

1) Wrap the unit in heavy paper or plastic. Tape loose edges.
2) Surround the wrapped unit in 2 to 4 inches (5 to 10 cm.) thick shock-absorbing material.
3) Place the package in a strong, double-walled shipping container. Fill excess spaces with newspaper.
4) Seal the container securely.
5) Mark the container: FRAGILE - DELICATE ELECTRONIC INSTRUMENT.

B. Boards

15.05 To remove boards from Model 43-01, refer to Section 14.

C. Individual Boards

15.06 When a board has been extracted from the Model 43-01, handle the board by the top and bottom edges of the board only. DO NOT handle the rear edge connector. Static electricity may damage the CMOS IC's on the board(s).

15.07 If the board is being returned to HLI for servicing or repair, enclose the following information:

- Type of service or repair required
- Model and serial number of the Model 43-01 from which the board was extracted
- Serial number of the board
- Return address
- Listing of symptoms if repair is required
- Name and telephone number of person to contact concerning the repair or service

Retain a copy of all information for yourself and refer to your copy in any correspondence with HLI.

15.08 Boards shipped separately from the factory are enclosed in a special conductive envelope that protects the circuitry from static electricity. This protective envelope should be retained and used for reshipment. If the conductive envelope is not available, DO NOT wrap the board in an ordinary plastic bag or plastic sheeting. Instead, proceed as follows:

1) If available, cover the entire rear edge connector with a conductive shorting bar.

2) Wrap the board in heavy kraft paper.
3) Surround the wrapped unit in 2 to 4 inches (5 to 10 cm.) thick shock-absorbing material.
4) Place the package in a strong, double-walled shipping container. Fill excess spaces with newspapers.
5) Seal the container securely.
6) Mark the container: FRAGILE - DELICATE ELECTRONIC INSTRUMENT

16. PARTS LIST

16.01 This section contains the parts list for the Model 43-01 Wideband Transmission Test Set subassemblies as listed in Table J.

TABLE J. PARTS LIST FOR MODEL 43-01 ASSEMBLIES

ASSEMBLY NUMBER	DESCRIPTION	PAGE NUMBER
4301-08	43-01 WTTS E/W BATTERY SUPPLY	16-1
4301-100	CHASSIS ASSY	16-2
4301-106	Front Cover Assy	16-2
4301-107	Case Assy	16-2
4301-109	Center Deck Assy	16-3
4301-120	Mechanical Center Deck Assy	16-3
4301-111	Interface Assy	16-4
4301-123	Thumb Wheel Assy	16-4
4301-124	Interface PC Assy	16-5
4301-125	Pot Bracket Assy	16-6
4301-129	Mechanical Front Panel Assy	16-6
4301-101	DIGITAL ASSY	16-7
4301-102	GENERATOR ASSY	16-10
4301-103	ANALOG ASSY	16-13
4301-113	Analog PC Assy	16-14
4301-104	INPUT/OUTPUT ASSY	16-20
4301-115	Shielded Capacitor Assy	16-20
4301-114	Input/Output PC Assy Board	16-20
4301-105	POWER SUPPLY ASSY	16-26

PART: 4301-08
DESC: 43-01 WTTS E/W BATTERY SUPPLY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
SUB	1.00	4301-100	CHASSIS ASSY
	1.00	4301-101T	TESTED DIGITAL ASSY
	1.00	4301-102T	TESTED GENERATOR ASSY
	1.00	4301-103T	TESTED ANALOG ASSY
	1.00	4301-104T	TESTED I/O ASSY
	1.00	4301-105T	TESTED POWER SUPPLY ASSY

PART: 4301-100
DESC: CHASSIS ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
	2.00	23C00006	KNOB 1/4 BLACK DOUBLE BAR SML
	3.00	23C00009	KNOB 1/4 BLACK ROUND
	4.00	23E00009	BUMPER FEET
	8.00	23Z00026	MISC HRDWR CARD GUIDE 4"
	4.00	24A08004B	SCREW 8-32X1/4 PH-CR-SS NYLOK
	12.00	24A04005B	SCREW 4-40x5/16 PH-CR-SS NYLOK
	1.00	24A04008B	SCREW 4-40x1/2 PH-CR-SS NYLK
	1.00	24A04101	WASHER FLAT #4 SCP MS15795-803
	13.00	24A04111	WASHER EXT TOOTH #4 SS
	4.00	24A04210	NUT HEX #4 SS
	4.00	24A06004B	SCREW 6-32X1/4 PH-CR-SS NYLOK
	4.00	24A06008B	SCREW 6-32X1/2 PH-CR-SS NYLOK
	4.00	24A06109	WASHER EXT TOOTH #6 SS
	4.00	24A08108	WASHER FLAT #8 SS
	1.00	F4301-011	A REAR PANEL LABEL
	1.00	F4301-0-2-014	C BRACKET BATTERY PACK
	2.00	F3900-038	FOAM CUSHION
	1.00	F4301-0-210	CARD GUIDE LEFT SIDE
	1.00	F4301-0-211	CARD GUIDE RIGHT SIDE
REF	0.00	D4301-0	UNIT ASSY TRANS TEST SET DWG
SUB	1.00	4301-106	FRONT COVER ASSY
SUB	1.00	4301-107	CASE ASSY
SUB	1.00	4301-108	BATTERY PACK ASSY
SUB	1.00	4301-109	CENTER DECK ASSY
SUB	1.00	4301-111	INTERFACE ASSY
SUB	1.00	4301-119	HANDLE MODIFIED
SUB	1.00	4301-129	MECH FRONT PANEL ASSY

PART: 4301-106
DESC: FRONT COVER ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
	1.00	19M00010	CABLE POWER 3 COND 5'
REF	0.00	C4301-0-1	FRONT COVER ASSY DWG
REF	0.00	D4301-1003	ASSY DIAGRAM FRONT COVER
SUB	1.00	4301-116	LID ASSY
SUB	1.00	4301-117	INNER LID ASSY

PART: 4301-107
DESC: CASE ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
	8.00	23E00002	BUMPER FEET
	8.00	24A06006B	SCREW 6-32X3/8 PH-CR-SS NYLOK
	8.00	24A06205	NUT 6-32 LCK NY INSERT SCP
	1.00	F4301-0-010	CASE
REF	0.00	D4301-0	UNIT ASSY TRANS TEST SET DWG
REF	0.00	D4301-1001	ASSY DIAGRAM CASE

PART: 4301-109
DESC: CENTER DECK ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 001	1.00	01A11000A1	CAP CER .01uF GMV 1.6KV
C 002	1.00	01A11000A1	CAP CER .01uF GMV 1.6KV
	2.00	23A00004	SPACER #4 SPL AL 3/16 X 9/16
	4.00	24A04004C3	SCREW 4-40X1/4 UC-FH-CR-SS NYK
	2.00	24A04016B	SCREW 4-40X1 PH-CR-SS NYLOK
	4.00	24A04109	WASHER FLAT #4 SS
	2.00	24A04111	WASHER EXT TOOTH #4 SS
	2.00	24A04210	NUT HEX #4 SS
	1.00	F4301-0-2-011	RECEPTACLE GUIDE
REF	0.00	D4301-0-2-0	CENTER DECK ASSY DWG
SUB	1.00	4301-118	TRANSFORMER ASSY
SUB	1.00	4301-120	MECH CENTER DECK ASSY

PART: 4301-120
DESC: MECH CENTER DECK ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
	1.00	23D00050	HOLDER FUSE
	1.00	24A04210	NUT HEX #4 SS
	1.00	24C00004	LUG SOLDER 909
	1.00	24A04004C3	SCREW 4-40X1/4 UC-FH-CR-SS NYK
	2.00	23Z00023	CARD GUIDE 3"
	1.00	26A00002	FUSE 1/2 A SB 250V
	1.00	F4301-0-2-012	CENTER DECK
REF	0.00	D4301-0-2-0	CENTER DECK ASSY DWG

PART: 4301-111
DESC: INTERFACE ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
LS 001	1.00	17A00003	SPEAKER 8 OHM 1W 2" ROUND
R 001	1.00	13C11000A3	RES CARBON 10K 20% .5W 1 T
	1.00	24A04004B2	SCREW 4-40x1/4 PH-CR-SS NYLK
	2.00	24A04005B	SCREW 4-40x5/16 PH-CR-SS NYLOK
	2.00	24A04210	NUT HEX #4 SS
	2.00	24A04111	WASHER EXT TOOTH #4 SS
	1.00	24Z00009	WASHER FLAT 1/4 SCP
	2.00	24A01016G	SCREW 1-64 X 1 RH-SL-SNP
	2.00	24A01101	WASHER SPLIT #1 SCP
	2.00	24A01102	WASHER FLAT #1 SCP
	2.00	24A01201	NUT HEX 1-64 SCP
	3.00	24Z00023	WASHER INT LOCK 3/8 SCP
	3.00	24Z00023	WASHER INT LOCK 3/8 SCP
	1.00	24Z00048	WASHER FLAT 1/4 NY
	1.00	24A08005F	SCREW 8-32 X 5/16 FIL-SL-NYLON
	0.60	29H00003	TUBING TEFLON #24
	0.60	29F00001	WIRE #24 BUS
	0.70	29F00003	WIRE #24 STRAND 1KV WHITE
	1.00	F4301-0-2-115	SPEAKER MOUNT
	1.00	F4301-0-2-116	B SPEAKER CONE
REF	0.00	D4301-0-2-103	COMPONENT LAYOUT INTERFACE
REF	0.00	D4301-0-2-104	SCHEMATIC DIAGRAM INTERFACE
REF	0.00	B4301-0-2-120	CABLE HARNESS INTERFACE DWG
REF	0.00	A4301-0-2-176	WIRE LIST
REF	0.00	B4301-0-2-177	CABLE HARNESS ASSY
REF	0.00	A4301-0-2-186	WIRE LIST
REF	0.00	B4301-0-2-187	CABLE HARNESS ASSY
SUB	1.00	4301-121	CABLE HARNESS ASSY #1
SUB	1.00	4301-122	CABLE HARNESS ASSY #2
SUB	1.00	4301-123	THUMBWHEEL ASSY
SUB	1.00	4301-124	INTERFACE PC ASSY
SUB	1.00	4301-125	POT BRACKET ASSY

PART: 4301-123
DESC: THUMBWHEEL ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
D 001	1.00	11A00001	LED RED T-1 3/4
D 002	1.00	11A00002	LED GREEN T-1 3/4
XF 001	2.00	20D00001	SOCKET LED
	0.25	28Z00004	CLSD CELL FOAM 1/16 THICK
	1.00	F4301-0-2-110	THUMBWHEEL SWITCH
	1.00	F4301-0-2-111	BRACKET THUMBWHEEL SW&LEDS
REF	0.00	D4301-1004	MECH ASSY INTERFACE
REF	0.00	D4301-0-2-103	COMPONENT LAYOUT INTERFACE

PART: 4301-124
DESC: INTERFACE PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 001	1.00	01F22200E	CAP POLYEST .22uF 10% 100V
C 002	1.00	01F22200E	CAP POLYEST .22uF 10% 100V
C 003	1.00	01H52200	CAP AL EL 220uF -10 +50% 16V
C 004	1.00	01H52200	CAP AL EL 220uF -10 +50% 16V
C 005	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 006	1.00	01A14700	CAP CER .047uF 20% 50V
C 007	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 008	1.00	01H51000A2	CAP AL EL 100uF -20 +20% 16V
C 009	1.00	01H51000A2	CAP AL EL 100uF -20 +20% 16V
C 010	1.00	01H51000A2	CAP AL EL 100uF -20 +20% 16V
C 011	1.00	01H51000A2	CAP AL EL 100uF -20 +20% 16V
IC 001	1.00	09Z00386	IC LINEAR 386 AUDIO AMP
J 001	1.00	19D00012	CONN 310 3 COND FEM PC MOUNT
J 002	1.00	19D00012	CONN 310 3 COND FEM PC MOUNT
J 007	1.00	19D00012	CONN 310 3 COND FEM PC MOUNT
Q 001	1.00	05C04401	TRANSISTOR NPN 2N4401
Q 002	1.00	05C04401	TRANSISTOR NPN 2N4401
R 004	1.00	12BD3300	RES CARBON 330 OHM 5% 1/4W
R 005	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 006	1.00	12BD3300	RES CARBON 330 OHM 5% 1/4W
R 007	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 008	1.00	12FD1620	RES MET FLM 162 OHM 1% 1/4W
R 009	1.00	12FD9090	RES MET FLM 909 OHM 1% 1/4W
R 010	1.00	12F01780	RES MET FLM 1.78K 1% 1/4W
R 011	1.00	12F01150	RES MET FLM 1.15K 1% 1/4W
R 013	1.00	12B02000	RES CARBON 2.0K 5% 1/4W
R 014	1.00	12DD3300	RES CARBON 330 OHM 5% 1W
R 015	1.00	12F11070	RES MET FLM 10.7K 1% 1/4W
R 016	1.00	12F03010	RES MET FLM 3.01K 1% 1/4W
R 017	1.00	12FD4990	RES MET FLM 499 OHM 1% 1/4W
R 018	1.00	12BB2700	RES CARBON 2.7 OHM 5% 1/4W
R 019	1.00	12BC1000	RES CARBON 10 OHM 5% 1/4W
R 020	1.00	12CB2700	RES CARBON 2.7 OHM 5% 1/2W
R 021	1.00	12CC1000	RES CARBON 10 OHM 5% 1/2W
R 022	1.00	12CB2700	RES CARBON 2.7 OHM 5% 1/2W
R 023	1.00	12CC1000	RES CARBON 10 OHM 5% 1/2W
R 024	1.00	12CB2700	RES CARBON 2.7 OHM 5% 1/2W
R 025	1.00	12CB1000	RES CARBON 1.0 OHM 5% 1/2W
S 001	1.00	21E00028	SW TOGGLE FPDT CTR OFF W/W
S 002	1.00	21E00025	SW TOGGLE DPDT CTR OFF W/W
S 003	1.00	21E00026	SW TOGGLE DPDT CTR OFF MOM W/W
S 005	1.00	F4301-0-2-114	ROT SW 7 POS SPEC CTRL DWG
S 006	1.00	21E00023	SW TOGGLE DPDT WIRE WRAP
S 007	1.00	F4301-0-2-113	ROT SW 6 POS SPEC CTRL DWG
S 008	1.00	21E00023	SW TOGGLE DPDT WIRE WRAP
S 009	1.00	21E00028	SW TOGGLE FPDT CTR OFF W/W
S 010	1.00	21E00027	SW TOGGLE 4PDT WIRE WRAP
S 011	1.00	21E00027	SW TOGGLE 4PDT WIRE WRAP
S 012	1.00	21E00027	SW TOGGLE 4PDT WIRE WRAP
S 013	1.00	21E00027	SW TOGGLE 4PDT WIRE WRAP
S 014	1.00	21E00024	SW TOGGLE DPDT CTR OFF W/W
TR 001	1.00	26D00001	SURGE ABSORBER 230V
TR 002	1.00	26D00001	SURGE ABSORBER 230V
TR 003	1.00	26D00001	SURGE ABSORBER 230V
TR 004	1.00	26D00001	SURGE ABSORBER 230V

PART: 4301-124
DESC: INTERFACE PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
XA 001	1.00	19F00018	CONN EDGE 22 PR COND PCB
XA 002	1.00	19F00019	CONN EDGE 15 PR COND PCB
XA 003	1.00	19F00018	CONN EDGE 22 PR COND PCB
XA 004	1.00	19F00018	CONN EDGE 22 PR COND PCB
XA 005	1.00	19F00019	CONN EDGE 15 PR COND PCB
	3.00	24Z00023	WASHER INT LOCK 3/8 SCP
	8.00	24A04303	NUT PEM KF2-440 SCP
	1.00	F4301-0-2-102	PCB INTERFACE
REF	0.00	D4301-0-2-103	COMPONENT LAYOUT INTERFACE
REF	0.00	D4301-0-2-104	SCHEMATIC DIAGRAM INTERFACE

PART: 4301-125
DESC: POT BRACKET ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 002	1.00	13B12000A3	RES WW 20K 5% 2W 10 T LT
R 003	1.00	13B12000A2	RES CARBON 20K 30% .5W 10 T
	1.00	23A00110	STNDOFF #4 RND AL 1/4 X 13/16
	1.00	24A04112	WASHER INT TOOTH #4 SS
	1.00	24A04004B2	SCREW 4-40x1/4 PH-CR-SS NYLK
	1.00	F4301-0-2-112	B BRACKET GEN CTRL POTS
REF	0.00	D4301-0-2-103	COMPONENT LAYOUT INTERFACE
REF	0.00	D4301-0-2-104	SCHEMATIC DIAGRAM INTERFACE

PART: 4301-129
DESC: MECH FRONT PANEL ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
P 001	1.00	19C00007	CONN BINDING POST METAL
P 002	4.00	19C00008	CONN BINDING POST BLACK
	2.00	23A00007	STNDOFF #4 RND BR 3/16 X 1
	4.00	23A00078	STNDOFF #8 M/F SS 1/4 X 8
	4.00	23A00079	STNDOFF #6 RND AL 1/4 X 3/4
	2.00	23L00003	HANDLE RND BLACK
	2.00	24A04006A1	SCREW 4-40 X 3/8 BH-SL-SBOC
	4.00	24A06107	WASHER FLAT #6 SS
	2.00	24C00007	LUG SOLDER 1416-8
	2.00	24A04108	WASHER FLAT #4 BLACK OXIDE
	0.50	29F00012	WIRE #24 STRAND 1KV BLACK
	1.00	F4301-0-2-212	FRAME FRONT PANEL
	1.00	F4301-0-2-211	FRONT PANEL
REF	0.00	D4301-1002	FRONT PANEL ASSY DIAGRAM
REF	0.00	D4301-0-2-2	FRONT PANEL ASSY DWG

PART: 4301-101
DESC: DIGITAL ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 001	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 002	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 003	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 004	1.00	01A11000	CAP CER .01uF 20% 50V
C 005	1.00	01A11000	CAP CER .01uF 20% 50V
C 006	1.00	01A11000	CAP CER .01uF 20% 50V
C 007	1.00	01A11000	CAP CER .01uF 20% 50V
C 008	1.00	01A11000	CAP CER .01uF 20% 50V
C 009	1.00	01B00100C1	CAP MICA 100pF 5% 500V
C 010	1.00	01B00015C	CAP MICA 15pF 5% 500V
C 011	1.00	01B00015C	CAP MICA 15pF 5% 500V
C 012	1.00	01A11000	CAP CER .01uF 20% 50V
C 013	1.00	01A11000	CAP CER .01uF 20% 50V
C 014	1.00	01B00220C	CAP MICA 220pF 5% 500V
C 015	1.00	01A11000	CAP CER .01uF 20% 50V
C 016	1.00	01A11000	CAP CER .01uF 20% 50V
C 017	1.00	01B00220C	CAP MICA 220pF 5% 500V
C 018	1.00	01H32200L	CAP AL EL 2.2uF -20 +20% 50V
C 019	1.00	01B00033C	CAP MICA 33pF 5% 500V
C 020	1.00	01A11000	CAP CER .01uF 20% 50V
C 021	1.00	01A11000	CAP CER .01uF 20% 50V
C 022	1.00	01A11000	CAP CER .01uF 20% 50V
C 023	1.00	01A11000	CAP CER .01uF 20% 50V
C 024	1.00	01A11000	CAP CER .01uF 20% 50V
C 025	1.00	01A11000	CAP CER .01uF 20% 50V
C 026	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 027	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
D 010	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 011	1.00	03A03064	DIODE SIGNAL 1N3064 75V
DS 001	1.00	11C00003	LED +1 RED 5082-7616 5/16"
DS 002	1.00	11B00004	LED 7 SEG RED 5082-7611 5/16"
DS 003	1.00	11B00004	LED 7 SEG RED 5082-7611 5/16"
DS 004	1.00	11B00004	LED 7 SEG RED 5082-7611 5/16"
DS 005	1.00	11C00003	LED +1 RED 5082-7616 5/16"
DS 006	1.00	11B00004	LED 7 SEG RED 5082-7611 5/16"
DS 007	1.00	11B00004	LED 7 SEG RED 5082-7611 5/16"
DS 008	1.00	11B00004	LED 7 SEG RED 5082-7611 5/16"
DS 009	1.00	11B00004	LED 7 SEG RED 5082-7611 5/16"
IC 001	1.00	07G04059	IC CMOS 4059 CNTR DIV BY N
IC 002	1.00	07G04042	IC CMOS 4042B LATCH D QUAD
IC 003	1.00	07G04017	IC CMOS 4017 CNTR DEC 5 STG
IC 004	1.00	07G04510	IC CMOS 4510B CNTR 4 BIT BCD
IC 006	1.00	07G04001A	IC CMOS 4001B NOR QUAD 2-IN
IC 007	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 008	1.00	07G04001A	IC CMOS 4001B NOR QUAD 2-IN
IC 009	1.00	07G04050	IC CMOS 4050 BFR/LVL CONV HEX
IC 012	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 013	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 014	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 015	1.00	07G04069A	IC CMOS 4069UB INVERTER HEX
IC 016	1.00	07G04069A	IC CMOS 4069UB INVERTER HEX
IC 017	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 018	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 019	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 020	1.00	07G04042	IC CMOS 4042B LATCH D QUAD
IC 021	1.00	07G04001A	IC CMOS 4001B NOR QUAD 2-IN

PART: 4301-101
DESC: DIGITAL ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
IC 022	1.00	07G04070	IC CMOS 4070B EXOR QUAD 2-IN
IC 023	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 024	1.00	07G04018A	IC CMOS 4018B CNTR DIVID BY N
IC 025	1.00	07G04017	IC CMOS 4017 CNTR DEC 5 STG
IC 026	1.00	07K05007	IC PMOS 5007 CNTR/DCOD
IC 027	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 028	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 029	1.00	07G04068A	IC CMOS 4068B NAND 8-IN
IC 030	1.00	07G04081	IC CMOS 4081B AND QUAD 2-IN
IC 031	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 032	1.00	07G04069A	IC CMOS 4069UB INVERTER HEX
IC 033	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 034	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 035	1.00	07G14538	IC CMOS 14538B MLTVIB DU PREC
IC 036	1.00	07K05007	IC PMOS 5007 CNTR/DCOD
IC 037	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 038	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 039	1.00	07K05007	IC PMOS 5007 CNTR/DCOD
IC 040	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 041	1.00	07G04017	IC CMOS 4017 CNTR DEC 5 STG
IC 042	1.00	07G04504	IC CMOS 14504B LVL SHFTR HEX
IC 043	1.00	07G04023	IC CMOS 4023B NAND TRIPLE 3-IN
IC 044	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 045	1.00	07G04518A	IC CMOS 4518 CNTR DUAL BCD UP
IC 046	1.00	07K05007	IC PMOS 5007 CNTR/DCOD
IC 047	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 048	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 049	1.00	07K05007	IC PMOS 5007 CNTR/DCOD
IC 050	1.00	07G04049A	IC CMOS 4049UB INV HEX UNBUFF
IC 051	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 052	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 053	1.00	07G04520A	IC CMOS 4520 CNTR DUAL BIN UP
IC 054	1.00	07G04073	IC CMOS 4073B AND TRIPLE 3-IN
IC 055	1.00	07G04518A	IC CMOS 4518 CNTR DUAL BCD UP
IC 056	1.00	07K05007	IC PMOS 5007 CNTR/DCOD
IC 057	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 058	1.00	07G14503	IC CMOS 14503B BFR HEX 3 STATE
IC 059	1.00	07G04068A	IC CMOS 4068B NAND 8-IN
IC 060	1.00	07G04049A	IC CMOS 4049UB INV HEX UNBUFF
IC 061	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 065	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 066	1.00	07G04081	IC CMOS 4081B AND QUAD 2-IN
IC 067	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 068	1.00	07G04081	IC CMOS 4081B AND QUAD 2-IN
IC 069	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 071	1.00	07H07212	IC CMOS 7212A DCOD/DRV 4 DIG
IC 072	1.00	07H07212	IC CMOS 7212A DCOD/DRV 4 DIG
Q 001	1.00	05C04401	TRANSISTOR NPN 2N4401
R 001	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 002	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 003	1.00	12BB2700	RES CARBON 2.7 OHM 5% 1/4W
R 004	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 005	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 006	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 007	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 008	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 009	1.00	12B14700	RES CARBON 47K 5% 1/4W

PART: 4301-101
DESC: DIGITAL ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 010	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 011	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 012	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 013	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 014	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 015	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 016	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 017	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 018	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 019	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 020	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 021	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 022	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 023	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 024	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 025	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 026	1.00	12B11200	RES CARBON 12K 5% 1/4W
R 027	1.00	12B02000	RES CARBON 2.0K 5% 1/4W
R 028	1.00	12B31000	RES CARBON 1.0M 5% 1/4W
RC 001	1.00	14A22200	RES NETWRK SIP 220K 2% 1/8W
RC 002	1.00	14A01000	RES NETWRK DIP 1K 2% 1/4W
	1.00	23E00005	BUMPER FEET ROUND
	0.30	29L00001	WIRE #14 BUS
	1.00	F4301-102	PCB DIGITAL
REF	0.00	D4301-103	COMPONENT LAYOUT DIGITAL
REF	0.00	D4301-104	SCHEMATIC DIAGRAM DIGITAL
REF	0.00	B4301-110	DISPLAY SUPPORT DWG

PART: 4301-102
DESC: GENERATOR ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 001	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 002	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 003	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 004	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 005	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 006	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 007	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 008	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 009	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 010	1.00	01B00100C1	CAP MICA 100pF 5% 500V
C 011	1.00	01B00200C	CAP MICA 200pF 5% 500V
C 012	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 013	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 014	1.00	01B00033C	CAP MICA 33pF 5% 500V
C 015	1.00	01B00130C	CAP MICA 130pF 5% 500V
C 016	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 017	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 018	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 019	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 020	1.00	01B00470C	CAP MICA 470pF 5% 500V
C 021	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 022	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 023	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 024	1.00	01B00270C	CAP MICA 270pF 5% 500V
C 025	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 026	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 027	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 028	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 029	1.00	01B00015C	CAP MICA 15pF 5% 500V
C 030	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 031	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 033	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 034	1.00	01G42200	CAP TANT EL 22uF 10% 15V
C 035	1.00	01G32200	CAP TANT EL 2.2uF 10% 20V
C 036	1.00	01G32200	CAP TANT EL 2.2uF 10% 20V
C 037	1.00	01A11000	CAP CER .01uF 20% 50V
C 038	1.00	01A11000	CAP CER .01uF 20% 50V
C 039	1.00	01B00015C	CAP MICA 15pF 5% 500V
C 040	1.00	01B00033C	CAP MICA 33pF 5% 500V
C 041	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 042	1.00	01A11000	CAP CER .01uF 20% 50V
C 043	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 044	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 045	1.00	01A11000	CAP CER .01uF 20% 50V
C 046	1.00	01C11000	CAP POLYPROP .01uF 2.5% 160V
C 047	1.00	01C11000	CAP POLYPROP .01uF 2.5% 160V
C 048	1.00	01G42200	CAP TANT EL 22uF 10% 15V
C 049	1.00	01B00330C	CAP MICA 330pF 5% 500V
C 050	1.00	01C01600	CAP POLYPROP 1600pF 2.5% 160V
C 051	1.00	01C01600	CAP POLYPROP 1600pF 2.5% 160V
C 052	1.00	01B00330C	CAP MICA 330pF 5% 500V
C 053	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 054	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 055	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 056	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 057	1.00	01F24700E	CAP POLYEST .47uF 10% 63V

PART: 4301-102
DESC: GENERATOR ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 058	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 059	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 060	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
D 001	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 002	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 003	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 004	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 005	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 006	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
D 007	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
IC 001	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 002	1.00	07G14569	IC CMOS 14569 CNTR DU PROG BCD
IC 003	1.00	07G04011A	IC CMOS 4011B NAND QUAD 2-IN
IC 004	1.00	07G04046A	IC CMOS 4046B PLL MICROPWR
IC 005	1.00	07M07474	IC CMOS 74HC74 F-F DUAL D
IC 006	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 007	1.00	07G04518A	IC CMOS 4518 CNTR DUAL BCD UP
IC 008	1.00	07G04013A	IC CMOS 4013B F-F DUAL D
IC 009	1.00	07G04069A	IC CMOS 4069UB INVERTER HEX
IC 010	1.00	07G04059	IC CMOS 4059 CNTR DIV BY N
IC 012	1.00	07G04023	IC CMOS 4023B NAND TRIPLE 3-IN
IC 013	1.00	07G04520A	IC CMOS 4520 CNTR DUAL BIN UP
IC 014	1.00	07G04015A	IC CMOS 4015B REG SHFT DU 4STG
IC 015	1.00	07G04518A	IC CMOS 4518 CNTR DUAL BCD UP
IC 016	1.00	07G04518A	IC CMOS 4518 CNTR DUAL BCD UP
IC 017	1.00	07G04050	IC CMOS 4050 BFR/LVL CONV HEX
IC 018	1.00	07G14538	IC CMOS 14538B MLTVIB DU PREC
IC 019	1.00	08B04558	IC OP AMP 4558 DUAL COMPEN
IC 020	1.00	07G04068A	IC CMOS 4068B NAND 8-IN
IC 021	1.00	07G04001A	IC CMOS 4001B NOR QUAD 2-IN
IC 022	1.00	07G04023	IC CMOS 4023B NAND TRIPLE 3-IN
IC 023	1.00	07G04017	IC CMOS 4017 CNTR DEC 5 STG
IC 024	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 025	1.00	08B00353	IC OP AMP 353 DUAL BIFET
IC 026	1.00	09Z13600	IC LINEAR 13600 OTA DUAL
IC 027	1.00	08B00353	IC OP AMP 353 DUAL BIFET
K 001	1.00	22C00023	RELAY 1 FORM A 500 OHM 5V
K 002	1.00	22C00023	RELAY 1 FORM A 500 OHM 5V
K 003	1.00	22C00023	RELAY 1 FORM A 500 OHM 5V
K 004	1.00	22C00023	RELAY 1 FORM A 500 OHM 5V
Q 001	1.00	05C04401	TRANSISTOR NPN 2N4401
Q 002	1.00	05C04401	TRANSISTOR NPN 2N4401
Q 003	1.00	05A04403	TRANSISTOR PNP 2N4403
R 001	1.00	12F21960	RES MET FLM 196K 1% 1/4W
R 002	1.00	12F12490	RES MET FLM 24.9K 1% 1/4W
R 003	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 004	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 005	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 006	1.00	12F21000	RES MET FLM 100K 1% 1/4W
R 007	1.00	12F12550	RES MET FLM 25.5K 1% 1/4W
R 008	1.00	12F06650	RES MET FLM 6.65K 1% 1/4W
R 009	1.00	12F02000	RES MET FLM 2.00K 1% 1/4W
R 010	1.00	12F21000	RES MET FLM 100K 1% 1/4W
R 011	1.00	12F14220	RES MET FLM 42.2K 1% 1/4W
R 012	1.00	12F02000	RES MET FLM 2.00K 1% 1/4W
R 013	1.00	12F21000	RES MET FLM 100K 1% 1/4W

PART: 4301-102
DESC: GENERATOR ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 014	1.00	12F02000	RES MET FLM 2.00K 1% 1/4W
R 015	1.00	12F21000	RES MET FLM 100K 1% 1/4W
R 016	1.00	12F02000	RES MET FLM 2.00K 1% 1/4W
R 017	1.00	12B11200	RES CARBON 12K 5% 1/4W
R 018	1.00	12F21000	RES MET FLM 100K 1% 1/4W
R 019	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 020	1.00	12F02000	RES MET FLM 2.00K 1% 1/4W
R 021	1.00	12F11820	RES MET FLM 18.2K 1% 1/4W
R 022	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 023	1.00	12F02550	RES MET FLM 2.55K 1% 1/4W
R 024	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 025	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 026	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 027	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 028	1.00	12F03740	RES MET FLM 3.74K 1% 1/4W
R 029	1.00	12F03740	RES MET FLM 3.74K 1% 1/4W
R 030	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 031	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 032	1.00	12B41000	RES CARBON 10M 5% 1/4W
R 033	1.00	12B02700	RES CARBON 2.7K 5% 1/4W
R 034	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 035	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 037	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 038	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 039	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 040	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 041	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 042	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 043	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 044	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 045	1.00	12J11938	RES MET FLM 19.38K .1% 1/10W
R 046	1.00	12J12290	RES MET FLM 22.90K .1% 1/10W
R 047	1.00	12J11938	RES MET FLM 19.38K .1% 1/10W
R 048	1.00	12J13437	RES MET FLM 34.37K .1% 1/10W
R 049	1.00	12J19833	RES MET FLM 98.33K .1% 1/10W
R 050	1.00	12J19833	RES MET FLM 98.33K .1% 1/10W
R 051	1.00	12J12290	RES MET FLM 22.90K .1% 1/10W
R 052	1.00	12J13437	RES MET FLM 34.37K .1% 1/10W
R 053	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 054	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 055	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 056	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 057	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 058	1.00	12B11000	RES CARBON 10K 5% 1/4W
R 059	1.00	13A15000	RES MET FLM 50K 10% .5W 1 T
R 060	1.00	12F01000	RES MET FLM 1.00K 1% 1/4W
R 061	1.00	12F16040	RES MET FLM 60.4K 1% 1/4W
R 062	1.00	12B11200	RES CARBON 12K 5% 1/4W
R 063	1.00	12F02000	RES MET FLM 2.00K 1% 1/4W
R 064	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 065	1.00	12F06650	RES MET FLM 6.65K 1% 1/4W
R 066	1.00	12F12000	RES MET FLM 20.0K 1% 1/4W
R 067	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 068	1.00	12F18660	RES MET FLM 86.6K 1% 1/4W
R 069	1.00	13A15000A3	RES MET FLM 50K 10% .5W 1 T
R 070	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W

PART: 4301-102
DESC: GENERATOR ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 071	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 072	1.00	12B11200	RES CARBON 12K 5% 1/4W
R 073	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 074	1.00	12B11200	RES CARBON 12K 5% 1/4W
R 075	1.00	12B11200	RES CARBON 12K 5% 1/4W
R 076	1.00	12B41000	RES CARBON 10M 5% 1/4W
R 077	1.00	12F03010	RES MET FLM 3.01K 1% 1/4W
R 078	1.00	12F03010	RES MET FLM 3.01K 1% 1/4W
R 079	1.00	12B31000	RES CARBON 1.0M 5% 1/4W
R 080	1.00	12F02150	RES MET FLM 2.15K 1% 1/4W
R 081	1.00	12FD2370	RES MET FLM 237 OHM 1% 1/4W
R 082	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 083	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 084	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 085	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 086	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 087	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 090	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 091	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 092	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 093	1.00	12B11000	RES CARBON 10K 5% 1/4W
R 094	1.00	12B11200	RES CARBON 12K 5% 1/4W
RC 001	1.00	14A22200	RES NETWRK SIP 220K 2% 1/8W
XY 001	1.00	25A00015	CRYSTAL 4.000MHZ 32pF .0025%
	1.00	F4301-202	PCB GENERATOR
REF	0.00	D4301-203	COMPONENT LAYOUT GENERATOR
REF	0.00	D4301-204	SCHEMATIC DIAGRAM GENERATOR

PART: 4301-103
DESC: ANALOG ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
	2.00	23A00018	STNDOFF #2 RND NY 3/16 X 1/4
	2.00	24A02008B	SCREW 2-56X1/2 PH-CR-SS NYLK
	2.00	24A02106	WASHER INT TOOTH #2 SS
	2.00	24A02202	NUT HEX 2-56 SS
	1.00	F4301-311	B SHIELD
REF	0.00	D4301-303	COMPONENT LAYOUT ANALOG
REF	0.00	D4301-304	SCHEMATIC DIAGRAM ANALOG
SUB	1.00	4301-113	ANALOG PC ASSY
SUB	1.00	4301-112	ANALOG CABLE ASSY

PART: 4301-113
DESC: ANALOG PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 001	1.00	01A11000	CAP CER .01uF 20% 50V
C 002	1.00	01A11000	CAP CER .01uF 20% 50V
C 003	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 004	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 005	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 006	1.00	01B00200C	CAP MICA 200pF 5% 500V
C 007	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 008	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 009	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 010	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 011	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 012	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 013	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 014	1.00	01A11000	CAP CER .01uF 20% 50V
C 015	1.00	01A11000	CAP CER .01uF 20% 50V
C 016	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 017	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 018	1.00	01B00062C	CAP MICA 62pF 5% 500V
C 019	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 020	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 021	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 022	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 023	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 024	1.00	01A11000	CAP CER .01uF 20% 50V
C 025	1.00	01A11000	CAP CER .01uF 20% 50V
C 026	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 027	1.00	01A11000	CAP CER .01uF 20% 50V
C 028	1.00	01A11000	CAP CER .01uF 20% 50V
C 029	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 030	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 031	1.00	01B00470C	CAP MICA 470pF 5% 500V
C 032	1.00	01B00470C	CAP MICA 470pF 5% 500V
C 033	1.00	01G42200	CAP TANT EL 22uF 10% 15V
C 034	1.00	01G42200	CAP TANT EL 22uF 10% 15V
C 035	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 036	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 037	1.00	01A11000	CAP CER .01uF 20% 50V
C 038	1.00	01A11000	CAP CER .01uF 20% 50V
C 039	1.00	01B01000C	CAP MICA 1000pF 5% 100V
C 040	1.00	01G32200	CAP TANT EL 2.2uF 10% 20V
C 041	1.00	01G34700	CAP TANT EL 4.7uF 10% 35V
C 042	1.00	01G34700	CAP TANT EL 4.7uF 10% 35V
C 043	1.00	01A11000	CAP CER .01uF 20% 50V
C 044	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 045	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 046	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 047	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 048	1.00	01A11000	CAP CER .01uF 20% 50V
C 049	1.00	01B00027C	CAP MICA 27pF 5% 500V
C 050	1.00	01A11000	CAP CER .01uF 20% 50V
C 051	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 052	1.00	01A11000	CAP CER .01uF 20% 50V
C 053	1.00	01B00470C	CAP MICA 470pF 5% 500V
C 054	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 055	1.00	01F21000E	CAP POLYEST .1uF 10% 100V

PART: 4301-113
DESC: ANALOG PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 056	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 057	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 058	1.00	01B00056C	CAP MICA 56pF 5% 500V
C 059	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 060	1.00	01A11000	CAP CER .01uF 20% 50V
C 061	1.00	01A11000	CAP CER .01uF 20% 50V
C 063	1.00	01A11000	CAP CER .01uF 20% 50V
C 064	1.00	01A11000	CAP CER .01uF 20% 50V
C 066	1.00	01A11000	CAP CER .01uF 20% 50V
C 068	1.00	01F26800E	CAP POLYEST .68uF 10% 63V
C 069	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 070	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 071	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 072	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 073	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 074	1.00	01H31000	CAP AL EL 1.0uF -20 +20% 50V
C 075	1.00	01A11000	CAP CER .01uF 20% 50V
C 076	1.00	01A11000	CAP CER .01uF 20% 50V
C 077	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 078	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 079	1.00	01C02200	CAP POLYPROP 2200pF 2.5% 160V
C 080	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 081	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 082	1.00	01B00062C	CAP MICA 62pF 5% 500V
C 083	1.00	01A11000	CAP CER .01uF 20% 50V
C 085	1.00	01A11000	CAP CER .01uF 20% 50V
C 086	1.00	01B01000C	CAP MICA 1000pF 5% 100V
C 087	1.00	01E24700A2	CAP POLYCARB .47uF 2% 50V
C 088	1.00	01E24700A2	CAP POLYCARB .47uF 2% 50V
C 089	1.00	01E24700A2	CAP POLYCARB .47uF 2% 50V
C 090	1.00	01A11000	CAP CER .01uF 20% 50V
C 091	1.00	01B01000C	CAP MICA 1000pF 5% 100V
C 092	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 093	1.00	01B00620C	CAP MICA 620pF 5% 300V
C 094	1.00	01A11000	CAP CER .01uF 20% 50V
C 095	1.00	01A11000	CAP CER .01uF 20% 50V
C 096	1.00	01A11000	CAP CER .01uF 20% 50V
C 097	1.00	01A11000	CAP CER .01uF 20% 50V
C 098	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 099	1.00	01B00036C	CAP MICA 36pF 5% 500V
C 100	1.00	01H61000A1	CAP AL EL 1000uF -20 +20% 35V
C 101	1.00	01A00020	CAP CER 20pF 5% 1KV
C 102	1.00	01A00047	CAP CER 47pF 20% 1KV
C 103	1.00	01A11000	CAP CER .01uF 20% 50V
D 001	1.00	03D00002A	DIODE ZENER LM329CZ 5% 6.9V
D 002	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 003	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 004	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 005	1.00	03A03064	DIODE SIGNAL 1N3064 75V
IC 001	1.00	08B04558	IC OP AMP 4558 DUAL COMPEN
IC 002	1.00	09B00393	IC LINEAR 393 COMP DUAL LW PWR
IC 003	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 004	1.00	08B00353	IC OP AMP 353 DUAL BIFET
IC 005	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 006	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 007	1.00	08A00318	IC OP AMP 318 WIDE BAND

PART: 4301-113
DESC: ANALOG PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
IC 008	1.00	07G04051	IC CMOS 4051 MUX/DMUX 8:1
IC 009	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 010	1.00	07G14538A1	IC CMOS 14538B MLTVIB DU PREC
IC 011	1.00	07G14538A1	IC CMOS 14538B MLTVIB DU PREC
IC 012	1.00	07G04070	IC CMOS 4070B EXOR QUAD 2-IN
IC 013	1.00	07G04001A	IC CMOS 4001B NOR QUAD 2-IN
IC 014	1.00	08A00318	IC OP AMP 318 WIDE BAND
IC 015	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 016	1.00	08A00318	IC OP AMP 318 WIDE BAND
IC 017	1.00	09C00339	IC LINEAR LM339 COMP QUAD
IC 018	1.00	09C00339	IC LINEAR LM339 COMP QUAD
IC 019	1.00	08A00318	IC OP AMP 318 WIDE BAND
IC 020	1.00	07G04516	IC CMOS 4516B CNTR 4 BIT UP/DN
IC 021	1.00	07G04510	IC CMOS 4510B CNTR 4 BIT BCD
IC 022	1.00	07G04071	IC CMOS 4071B OR QUAD 2-IN
IC 023	1.00	08A00318	IC OP AMP 318 WIDE BAND
IC 024	1.00	08B00353	IC OP AMP 353 DUAL BIFET
IC 025	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 026	1.00	08B04558	IC OP AMP 4558 DUAL COMPEN
IC 027	1.00	08A00318	IC OP AMP 318 WIDE BAND
IC 028	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 029	1.00	07G04051	IC CMOS 4051 MUX/DMUX 8:1
IC 030	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 031	1.00	08B00353	IC OP AMP 353 DUAL BIFET
IC 032	1.00	07G04510	IC CMOS 4510B CNTR 4 BIT BCD
IC 033	1.00	07G04510	IC CMOS 4510B CNTR 4 BIT BCD
IC 034	1.00	07G04081	IC CMOS 4081B AND QUAD 2-IN
IC 035	1.00	07G04059	IC CMOS 4059 CNTR DIV BY N
IC 036	1.00	07G04071	IC CMOS 4071B OR QUAD 2-IN
IC 037	1.00	07G04050	IC CMOS 4050 BFR/LVL CONV HEX
R 001	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 002	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 003	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 004	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 005	1.00	12B06200	RES CARBON 6.2K 5% 1/4W
R 006	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 007	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 008	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 009	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 010	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 011	1.00	12B06200	RES CARBON 6.2K 5% 1/4W
R 012	1.00	12B11200	RES CARBON 12K 5% 1/4W
R 013	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 014	1.00	12F03010	RES MET FLM 3.01K 1% 1/4W
R 015	1.00	12F03010	RES MET FLM 3.01K 1% 1/4W
R 016	1.00	12F22430	RES MET FLM 243K 1% 1/4W
R 017	1.00	12F16040	RES MET FLM 60.4K 1% 1/4W
R 018	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 019	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 020	1.00	12B15100	RES CARBON 51K 5% 1/4W
R 021	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 022	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 023	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 024	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 025	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W

PART: 4301-113
DESC: ANALOG PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 026	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 027	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 028	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 029	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 030	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 031	1.00	12J01903	RES MET FLM 1.903K .1% 1/10W
R 032	1.00	12JD2589	RES MET FLM 258.9 OHM .1% .1W
R 033	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 034	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 035	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 036	1.00	12J09000	RES MET FLM 9.000K .1% 1/10W
R 037	1.00	12J09000	RES MET FLM 9.000K .1% 1/10W
R 038	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 039	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 040	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 041	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 042	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 043	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 044	1.00	12F01870	RES MET FLM 1.87K 1% 1/4W
R 045	1.00	13A11000A4	RES MET FLM 10K 10% .5W 1 T
R 046	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 047	1.00	12J21000	RES MET FLM 100.0K .1% 1/10W
R 048	1.00	12J21000	RES MET FLM 100.0K .1% 1/10W
R 049	1.00	12F13160	RES MET FLM 31.6K 1% 1/4W
R 050	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 051	1.00	12B15600	RES CARBON 56K 5% 1/4W
R 052	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 053	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 054	1.00	12B15600	RES CARBON 56K 5% 1/4W
R 055	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 056	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 057	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 058	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 059	1.00	12F03400	RES MET FLM 3.40K 1% 1/4W
R 060	1.00	12F11870	RES MET FLM 18.7K 1% 1/4W
R 061	1.00	12F04530	RES MET FLM 4.53K 1% 1/4W
R 062	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 063	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 064	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 065	1.00	12F04220	RES MET FLM 4.22K 1% 1/4W
R 066	1.00	12F12000	RES MET FLM 20.0K 1% 1/4W
R 067	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 068	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 069	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 070	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 071	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 072	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 073	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 074	1.00	12J03385	RES MET FLM 3.385K .1% 1/10W
R 075	1.00	12JD2435	RES MET FLM 243.5 OHM .1% .1W
R 076	1.00	12JD2170	RES MET FLM 217.0 OHM .1% .1W
R 077	1.00	12JD1934	RES MET FLM 193.4 OHM .1% .1W
R 078	1.00	12JD1724	RES MET FLM 172.4 OHM .1% .1W
R 079	1.00	12JD1536	RES MET FLM 153.6 OHM .1% .1W
R 080	1.00	12JD1369	RES MET FLM 136.9 OHM .1% .1W

PART: 4301-113
DESC: ANALOG PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 081	1.00	12JD1220	RES MET FLM 122.0 OHM .1% .1W
R 082	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 083	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 084	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 085	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 086	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 087	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 088	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 089	1.00	12J09000	RES MET FLM 9.000K .1% 1/10W
R 090	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 091	1.00	12J01903	RES MET FLM 1.903K .1% 1/10W
R 092	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 093	1.00	12J09000	RES MET FLM 9.000K .1% 1/10W
R 094	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 095	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 096	1.00	12JD2589	RES MET FLM 258.9 OHM .1% .1W
R 097	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 098	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 099	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 100	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 101	1.00	12F15900	RES MET FLM 59.0K 1% 1/4W
R 102	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 103	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 104	1.00	12B02000	RES CARBON 2.0K 5% 1/4W
R 105	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 106	1.00	12F31000	RES MET FLM 1.00M 1% 1/4W
R 107	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 108	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 109	1.00	12F21000	RES MET FLM 100K 1% 1/4W
R 110	1.00	12F07150	RES MET FLM 7.15K 1% 1/4W
R 111	1.00	12F05900	RES MET FLM 5.90K 1% 1/4W
R 112	1.00	12F01070	RES MET FLM 1.07K 1% 1/4W
R 113	1.00	13A02000A3	RES MET FLM 2K 10% .5W 1 T
R 114	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 115	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 116	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 117	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 118	1.00	12B02000	RES CARBON 2.0K 5% 1/4W
R 119	1.00	12F28660	RES MET FLM 866K 1% 1/4W
R 120	1.00	12F24420	RES MET FLM 442K 1% 1/4W
R 121	1.00	12F22260	RES MET FLM 226K 1% 1/4W
R 122	1.00	12F21150	RES MET FLM 115K 1% 1/4W
R 123	1.00	12F31820	RES MET FLM 1.82M 1% 1/4W
R 124	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 125	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 126	1.00	12F12670	RES MET FLM 26.7K 1% 1/4W
R 127	1.00	12BC1000	RES CARBON 10 OHM 5% 1/4W
R 128	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 129	1.00	12F14990	RES MET FLM 49.9K 1% 1/4W
R 130	1.00	12BC1000	RES CARBON 10 OHM 5% 1/4W
R 131	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 132	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 133	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 134	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 135	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W

PART: 4301-113
DESC: ANALOG PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 136	1.00	12F03400	RES MET FLM 3.40K 1% 1/4W
R 137	1.00	12FD2430	RES MET FLM 243 OHM 1% 1/4W
R 140	1.00	12FD2150	RES MET FLM 215 OHM 1% 1/4W
R 141	1.00	12FD1910	RES MET FLM 191 OHM 1% 1/4W
R 142	1.00	12FD1740	RES MET FLM 174 OHM 1% 1/4W
R 143	1.00	12FD1540	RES MET FLM 154 OHM 1% 1/4W
R 144	1.00	12FD1370	RES MET FLM 137 OHM 1% 1/4W
R 145	1.00	12FD1210	RES MET FLM 121 OHM 1% 1/4W
R 146	1.00	12F01000	RES MET FLM 1.00K 1% 1/4W
R 147	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 148	1.00	12B15100	RES CARBON 51K 5% 1/4W
R 149	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 150	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 151	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 152	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 153	1.00	12B06200	RES CARBON 6.2K 5% 1/4W
R 154	1.00	12F12000	RES MET FLM 20.0K 1% 1/4W
R 155	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 156	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 157	1.00	12B06200	RES CARBON 6.2K 5% 1/4W
R 158	1.00	12F11270	RES MET FLM 12.7K 1% 1/4W
R 159	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 160	1.00	12B05100	RES CARBON 5.1K 5% 1/4W
R 161	1.00	12B06200	RES CARBON 6.2K 5% 1/4W
R 162	1.00	12F12150	RES MET FLM 21.5K 1% 1/4W
R 163	1.00	12F12150	RES MET FLM 21.5K 1% 1/4W
R 164	1.00	12F11270	RES MET FLM 12.7K 1% 1/4W
R 165	1.00	12F12000	RES MET FLM 20.0K 1% 1/4W
R 166	1.00	12F05110	RES MET FLM 5.11K 1% 1/4W
R 167	1.00	12F23090	RES MET FLM 309K 1% 1/4W
R 168	1.00	12F23090	RES MET FLM 309K 1% 1/4W
R 169	1.00	12F23090	RES MET FLM 309K 1% 1/4W
R 170	1.00	12B02000	RES CARBON 2.0K 5% 1/4W
R 171	1.00	12B02000	RES CARBON 2.0K 5% 1/4W
R 172	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 173	1.00	12B12200	RES CARBON 22K 5% 1/4W
RC 001	1.00	14A15600	RES NETWRK SIP 56K 2% 1/8W
RC 002	1.00	14A14700	RES NETWRK DIP 47K 2% 1/4W
RC 003	1.00	14A15600	RES NETWRK SIP 56K 2% 1/8W
RC 004	1.00	14A14700	RES NETWRK DIP 47K 2% 1/4W
RC 006	1.00	14A22200	RES NETWRK SIP 220K 2% 1/8W
RC 007	1.00	14A22200	RES NETWRK SIP 220K 2% 1/8W
	1.00	F4301-302	PCB ANALOG
REF	0.00	D4301-303	COMPONENT LAYOUT ANALOG
REF	0.00	D4301-304	SCHEMATIC DIAGRAM ANALOG

PART: 4301-104
DESC: I/O ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
REF	0.00	D4301-403	COMPONENT LAYOUT I/O
REF	0.00	D4301-404	SCHEMATIC DIAGRAM I/O
SUB	1.00	4301-115	SHIELDED CAP ASSY
SUB	1.00	4301-114	I/O PC ASSY

PART: 4301-115
DESC: SHIELDED CAP ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 001	1.00	01H51000A1	CAP AL EL 100uF -20 +20% 160V
C 004	1.00	01H51000A1	CAP AL EL 100uF -20 +20% 160V
	0.50	29B00003	WIRE SHIELDED #22 2 COND BLK
	0.20	29F00001	WIRE #24 BUS
	0.20	29H00004	TUBING TEFLON #22
	0.40	28A00007	TAPE COPPER 2 IN X 18 YD
	0.70	28A00001	TAPE MYLAR 3 IN X 72 YD
REF	0.00	C4301-4-0	SHIELDED CAP ASSY DWG

PART: 4301-114
DESC: I/O PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 005	1.00	01B00120C	CAP MICA 120pF 5% 500V
C 006	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 007	1.00	01A11000	CAP CER .01uF 20% 50V
C 008	1.00	01A11000	CAP CER .01uF 20% 50V
C 009	1.00	01B00015C	CAP MICA 15pF 5% 500V
C 010	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 011	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 012	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 013	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 014	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 015	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 016	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 017	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 018	1.00	01C12700	CAP POLYPROP .027uF 2.5% 160V
C 019	1.00	01C12700	CAP POLYPROP .027uF 2.5% 160V
C 020	1.00	01C12700	CAP POLYPROP .027uF 2.5% 160V
C 021	1.00	01C00820	CAP POLYPROP 820pF 2.5% 160V
C 022	1.00	01C12700	CAP POLYPROP .027uF 2.5% 160V
C 023	1.00	01C02000	CAP POLYPROP 2000pF 2.5% 160V
C 024	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 025	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 026	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 027	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 028	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 029	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 030	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 031	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 032	1.00	01B00022C	CAP MICA 22pF 5% 500V

PART: 4301-114
DESC: I/O PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 033	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 034	1.00	01C12000A	CAP POLYPROP .02uF 1% 160V
C 035	1.00	01C05000	CAP POLYPROP 5000pF 2.5% 160V
C 036	1.00	01C05000	CAP POLYPROP 5000pF 2.5% 160V
C 037	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 038	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 039	1.00	01C04700	CAP POLYPROP 4700pF 2.5% 160V
C 040	1.00	01C01000	CAP POLYPROP 1000pF 2.5% 160V
C 041	1.00	01C01500	CAP POLYPROP 1500pF 2.5% 160V
C 042	1.00	01C07500	CAP POLYPROP 7500pF 2.5% 160V
C 043	1.00	01C03300	CAP POLYPROP 3300pF 2.5% 160V
C 044	1.00	01C01300	CAP POLYPROP 1300pF 2.5% 160V
C 045	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 046	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 047	1.00	01A11000	CAP CER .01uF 20% 50V
C 048	1.00	01A11000	CAP CER .01uF 20% 50V
C 049	1.00	01A11000	CAP CER .01uF 20% 50V
C 050	1.00	01A11000	CAP CER .01uF 20% 50V
C 051	1.00	01C01000	CAP POLYPROP 1000pF 2.5% 160V
C 052	1.00	01A11000	CAP CER .01uF 20% 50V
C 053	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 054	1.00	01A11000	CAP CER .01uF 20% 50V
C 055	1.00	01C01000	CAP POLYPROP 1000pF 2.5% 160V
C 056	1.00	01B00047C	CAP MICA 47pF 5% 500V
C 057	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 058	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 059	1.00	01B00012C	CAP MICA 12pF 5% 500V
C 060	1.00	01H52200	CAP AL EL 220uF -10 +50% 16V
C 061	1.00	01C12700	CAP POLYPROP .027uF 2.5% 160V
C 062	1.00	01C12700	CAP POLYPROP .027uF 2.5% 160V
C 063	1.00	01C03900	CAP POLYPROP 3900pF 2.5% 160V
C 064	1.00	01C01200	CAP POLYPROP 1200pF 2.5% 160V
C 065	1.00	01C05000	CAP POLYPROP 5000pF 2.5% 160V
C 066	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 067	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 068	1.00	01C00510	CAP POLYPROP 510pF 2.5% 160V
C 069	1.00	01C02200	CAP POLYPROP 2200pF 2.5% 160V
C 070	1.00	01C02000	CAP POLYPROP 2000pF 2.5% 160V
C 071	1.00	01C02000	CAP POLYPROP 2000pF 2.5% 160V
C 072	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 073	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 074	1.00	01A11000	CAP CER .01uF 20% 50V
C 075	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 076	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 077	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 078	1.00	01A11000	CAP CER .01uF 20% 50V
C 079	1.00	01B00018C	CAP MICA 18pF 5% 500V
C 080	1.00	01H44700L	CAP AL EL 47uF -20 +20% 10V
C 081	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 082	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 083	1.00	01A11000	CAP CER .01uF 20% 50V
C 084	1.00	01A11000	CAP CER .01uF 20% 50V
C 085	1.00	01C01000	CAP POLYPROP 1000pF 2.5% 160V
C 086	1.00	01C02000	CAP POLYPROP 2000pF 2.5% 160V
C 087	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 088	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 089	1.00	01C11000	CAP POLYPROP .01uF 2.5% 160V

PART: 4301-114
DESC: I/O PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 090	1.00	01C05000	CAP POLYPROP 5000pF 2.5% 160V
C 091	1.00	01C03300	CAP POLYPROP 3300pF 2.5% 160V
C 092	1.00	01C03300	CAP POLYPROP 3300pF 2.5% 160V
C 093	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 094	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 095	1.00	01C01800	CAP POLYPROP 1800pF 2.5% 160V
C 096	1.00	01H32200L	CAP AL EL 2.2uF -20 +20% 50V
C 097	1.00	01H32200L	CAP AL EL 2.2uF -20 +20% 50V
C 100	1.00	01H51000A1	CAP AL EL 100uF -20 +20% 160V
C 101	1.00	01H51000A1	CAP AL EL 100uF -20 +20% 160V
C 102	1.00	01A11000	CAP CER .01uF 20% 50V
C 103	1.00	01A11000	CAP CER .01uF 20% 50V
C 104	1.00	01B00022C	CAP MICA 22pF 5% 500V
C 107	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 108	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 109	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 110	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 111	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 112	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 113	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 114	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
C 115	1.00	01B00022C	CAP MICA 22pF 5% 500V
C 116	1.00	01B00022C	CAP MICA 22pF 5% 500V
C 117	1.00	01B00430C	CAP MICA 430pF 5% 500V
C 118	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 119	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 120	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 121	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 122	1.00	02A00001	CAP VAR CER 5.5-18pF
C 123	1.00	01F21000E	CAP POLYEST .1uF 10% 100V
D 001	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 002	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 003	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 004	1.00	03A03064	DIODE SIGNAL 1N3064 75V
D 007	1.00	03J00001	DIODE BRIDGE 400V 1.5A
D 008	1.00	03J00001	DIODE BRIDGE 400V 1.5A
IC 001	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 002	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 003	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 004	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 005	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 006	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 007	1.00	07G04052	IC CMOS 4052 MUX/DMUX DUAL 4:1
IC 008	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 009	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
IC 010	1.00	08A05534	IC OP AMP 5534A LOW NOISE
IC 011	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 012	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 013	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 014	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 015	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 016	1.00	07G04052	IC CMOS 4052 MUX/DMUX DUAL 4:1
IC 017	1.00	08A05534	IC OP AMP 5534A LOW NOISE
IC 018	1.00	08B04558	IC OP AMP 4558 DUAL COMPEN
IC 019	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 020	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1

PART: 4301-114
DESC: I/O PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
IC 021	1.00	08B05532A	IC OP AMP 5532A DUAL LOW NOISE
IC 022	1.00	08A05534	IC OP AMP 5534A LOW NOISE
IC 023	1.00	08A05534	IC OP AMP 5534A LOW NOISE
IC 024	1.00	07G04053A	IC CMOS 4053 MUX/DMUX TRI 2:1
L 001	1.00	15A11000A	INDUCTOR 10.0mH 5% 76.6 OHM
L 002	1.00	15A11000A	INDUCTOR 10.0mH 5% 76.6 OHM
L 003	1.00	15A04700A2	INDUCTOR 4.7mH 5% 64.8 OHM
L 004	1.00	15A03300A1	INDUCTOR 3.3mH 5% 51.6 OHM
L 005	1.00	15A01000A	INDUCTOR 1.0mH 5% 24 OHM
L 006	1.00	15A01000A	INDUCTOR 1.0mH 5% 24 OHM
L 007	1.00	15AD4700	INDUCTOR 470uH 10%
Q 001	1.00	05D00007	TRANSISTOR NPN MPS-A14
Q 002	1.00	05C02484	TRANSISTOR NPN 2N2484
Q 003	1.00	05D00002	TRANSISTOR NPN MJE182
Q 004	1.00	05D00007	TRANSISTOR NPN MPS-A14
Q 005	1.00	05C02484	TRANSISTOR NPN 2N2484
Q 006	1.00	05D00002	TRANSISTOR NPN MJE182
R 001	1.00	12F12000	RES MET FLM 20.0K 1% 1/4W
R 002	1.00	12F12000	RES MET FLM 20.0K 1% 1/4W
R 003	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 004	1.00	12F18870	RES MET FLM 88.7K 1% 1/4W
R 005	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 006	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 007	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 008	1.00	12J11108	RES MET FLM 11.08K .1% 1/10W
R 009	1.00	12J11000	RES MET FLM 10.00K .1% 1/10W
R 010	1.00	12F11960	RES MET FLM 19.6K 1% 1/4W
R 011	1.00	12F13320	RES MET FLM 33.2K 1% 1/4W
R 012	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 013	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 014	1.00	13A02000	RES MET FLM 2K 10% .5W 1 T
R 015	1.00	12F07500	RES MET FLM 7.50K 1% 1/4W
R 016	1.00	12F03830	RES MET FLM 3.83K 1% 1/4W
R 017	1.00	12F11500	RES MET FLM 15.0K 1% 1/4W
R 018	1.00	12F11330	RES MET FLM 13.3K 1% 1/4W
R 019	1.00	12F06980	RES MET FLM 6.98K 1% 1/4W
R 020	1.00	12F11270	RES MET FLM 12.7K 1% 1/4W
R 021	1.00	12F05760	RES MET FLM 5.76K 1% 1/4W
R 022	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 023	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 024	1.00	12BC2200	RES CARBON 22 OHM 5% 1/4W
R 025	1.00	12BC2200	RES CARBON 22 OHM 5% 1/4W
R 026	1.00	12F04020	RES MET FLM 4.02K 1% 1/4W
R 027	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 028	1.00	12F11330	RES MET FLM 13.3K 1% 1/4W
R 029	1.00	12F04990	RES MET FLM 4.99K 1% 1/4W
R 030	1.00	13A02000	RES MET FLM 2K 10% .5W 1 T
R 031	1.00	12F12150	RES MET FLM 21.5K 1% 1/4W
R 032	1.00	12F11470	RES MET FLM 14.7K 1% 1/4W
R 033	1.00	12F02210	RES MET FLM 2.21K 1% 1/4W
R 034	1.00	12F04750	RES MET FLM 4.75K 1% 1/4W
R 035	1.00	12F04990	RES MET FLM 4.99K 1% 1/4W
R 036	1.00	13A02000	RES MET FLM 2K 10% .5W 1 T
R 037	1.00	12F11470	RES MET FLM 14.7K 1% 1/4W
R 038	1.00	12F12150	RES MET FLM 21.5K 1% 1/4W
R 039	1.00	12F02210	RES MET FLM 2.21K 1% 1/4W

PART: 4301-114
DESC: I/O PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 040	1.00	12F04750	RES MET FLM 4.75K 1% 1/4W
R 041	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 042	1.00	12F16980	RES MET FLM 69.8K 1% 1/4W
R 043	1.00	13A02000	RES MET FLM 2K 10% .5W 1 T
R 044	1.00	12F14420	RES MET FLM 44.2K 1% 1/4W
R 045	1.00	12F04990	RES MET FLM 4.99K 1% 1/4W
R 046	1.00	12F11470	RES MET FLM 14.7K 1% 1/4W
R 047	1.00	12F02210	RES MET FLM 2.21K 1% 1/4W
R 048	1.00	12F04320	RES MET FLM 4.32K 1% 1/4W
R 049	1.00	12F04020	RES MET FLM 4.02K 1% 1/4W
R 050	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 051	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 052	1.00	12F16490	RES MET FLM 64.9K 1% 1/4W
R 053	1.00	12F12490	RES MET FLM 24.9K 1% 1/4W
R 054	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 055	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 056	1.00	12F04990	RES MET FLM 4.99K 1% 1/4W
R 057	1.00	12F04990	RES MET FLM 4.99K 1% 1/4W
R 058	1.00	12F08250	RES MET FLM 8.25K 1% 1/4W
R 059	1.00	12F08250	RES MET FLM 8.25K 1% 1/4W
R 060	1.00	12F08250	RES MET FLM 8.25K 1% 1/4W
R 061	1.00	12F09760	RES MET FLM 9.76K 1% 1/4W
R 062	1.00	12F09760	RES MET FLM 9.76K 1% 1/4W
R 063	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 064	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 065	1.00	12F05230	RES MET FLM 5.23K 1% 1/4W
R 066	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 067	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 068	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 069	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 070	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 071	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 072	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 073	1.00	12F02490	RES MET FLM 2.49K 1% 1/4W
R 074	1.00	12F03090	RES MET FLM 3.09K 1% 1/4W
R 075	1.00	12F02610	RES MET FLM 2.61K 1% 1/4W
R 076	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 077	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 078	1.00	12F02740	RES MET FLM 2.74K 1% 1/4W
R 079	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 080	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 081	1.00	12F21960	RES MET FLM 196K 1% 1/4W
R 082	1.00	12F21960	RES MET FLM 196K 1% 1/4W
R 083	1.00	12F01300	RES MET FLM 1.30K 1% 1/4W
R 084	1.00	12F01330	RES MET FLM 1.33K 1% 1/4W
R 085	1.00	12F01330	RES MET FLM 1.33K 1% 1/4W
R 086	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 087	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 088	1.00	12F03160	RES MET FLM 3.16K 1% 1/4W
R 089	1.00	12F04220	RES MET FLM 4.22K 1% 1/4W
R 090	1.00	12F03240	RES MET FLM 3.24K 1% 1/4W
R 091	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 092	1.00	12FD1540	RES MET FLM 154 OHM 1% 1/4W
R 093	1.00	12F03090	RES MET FLM 3.09K 1% 1/4W
R 094	1.00	12F11000	RES MET FLM 10.0K 1% 1/4W
R 095	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 096	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W

PART: 4301-114
DESC: I/O PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 097	1.00	12B14700	RES CARBON 47K 5% 1/4W
R 098	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 099	1.00	12B12200	RES CARBON 22K 5% 1/4W
R 100	1.00	12J04623	RES MET FLM 4.623K .1% 1/10W
R 101	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 102	1.00	12J05000	RES MET FLM 5.000K .1% 1/10W
R 103	1.00	12J11081	RES MET FLM 10.81K .1% 1/10W
R 104	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 105	1.00	12J04623	RES MET FLM 4.623K .1% 1/10W
R 106	1.00	12J01000	RES MET FLM 1.000K .1% 1/10W
R 107	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 108	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 109	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 110	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 111	1.00	13A05000	RES MET FLM 5K 10% .5W 1 T
R 112	1.00	13A02000	RES MET FLM 2K 10% .5W 1 T
R 113	1.00	12F06190	RES MET FLM 6.19K 1% 1/4W
R 114	1.00	13A05000	RES MET FLM 5K 10% .5W 1 T
R 115	1.00	12F07500	RES MET FLM 7.50K 1% 1/4W
R 116	1.00	12F07500	RES MET FLM 7.50K 1% 1/4W
R 117	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 118	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 119	1.00	12F07500	RES MET FLM 7.50K 1% 1/4W
R 120	1.00	12F07500	RES MET FLM 7.50K 1% 1/4W
R 121	1.00	12F14750	RES MET FLM 47.5K 1% 1/4W
R 122	1.00	12F14750	RES MET FLM 47.5K 1% 1/4W
R 123	1.00	12FD3010	RES MET FLM 301 OHM 1% 1/4W
R 124	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 125	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 126	1.00	12F09090	RES MET FLM 9.09K 1% 1/4W
R 127	1.00	12F29090	RES MET FLM 909K 1% 1/4W
R 129	1.00	12F21000	RES MET FLM 100K 1% 1/4W
R 130	1.00	12FC3920	RES MET FLM 39.2 OHM 1% 1/4W
R 131	1.00	12FC3920	RES MET FLM 39.2 OHM 1% 1/4W
R 132	1.00	12F29090	RES MET FLM 909K 1% 1/4W
R 134	1.00	12F21000	RES MET FLM 100K 1% 1/4W
R 135	1.00	12FC3920	RES MET FLM 39.2 OHM 1% 1/4W
R 136	1.00	12FC3920	RES MET FLM 39.2 OHM 1% 1/4W
R 137	1.00	12FC6650	RES MET FLM 66.5 OHM 1% 1/4W
R 138	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 139	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 144	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 145	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 146	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 147	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 148	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 149	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 150	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 151	1.00	12BC4700	RES CARBON 47 OHM 5% 1/4W
R 152	1.00	12FD7150	RES MET FLM 715 OHM 1% 1/4W
R 153	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 154	1.00	12B01000	RES CARBON 1.0K 5% 1/4W
R 156	1.00	12FC6650	RES MET FLM 66.5 OHM 1% 1/4W
R 157	1.00	12FD7500	RES MET FLM 750 OHM 1% 1/4W
R 158	1.00	12B22200	RES CARBON 220K 5% 1/4W
R 159	1.00	13AD5000	RES MET FLM .5K 10% .5W 1 T
R 160	1.00	13AD5000	RES MET FLM .5K 10% .5W 1 T

PART: 4301-114
DESC: I/O PC ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 161	1.00	13AD5000	RES MET FLM .5K 10% .5W 1 T
R 162	1.00	12B12200	RES CARBON 22K 5% 1/4W
RT 001	1.00	14BD2000	THERMST 200 OHM @ 33C PDC 4.4%
RT 002	1.00	14BD2000	THERMST 200 OHM @ 33C PDC 4.4%
T 001	1.00	16A00030	XFRMR SIG 1:1CT 19.9H
T 002	1.00	16A00029	XFRMR SIG 3:1:1
	2.00	23E00006	BUMPER FEET ROUND
	2.00	19Z00003	CONN WIRE JUMPER
	2.00	23G00013	HEATSINK
	1.00	F4301-402	PCB I/O
REF	0.00	D4301-403	COMPONENT LAYOUT I/O
REF	0.00	D4301-404	SCHEMATIC DIAGRAM I/O

PART: 4301-105
DESC: POWER SUPPLY ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
C 001	1.00	01H61000A1	CAP AL EL 1000uF -20 +20% 35V
C 002	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 003	1.00	01H61000A1	CAP AL EL 1000uF -20 +20% 35V
C 004	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 005	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 006	1.00	01A11000	CAP CER .01uF 20% 50V
C 007	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 008	1.00	01A11000	CAP CER .01uF 20% 50V
C 009	1.00	01H61000A1	CAP AL EL 1000uF -20 +20% 35V
C 010	1.00	01F24700E	CAP POLYEST .47uF 10% 63V
C 011	1.00	01H42200L	CAP AL EL 22uF -20 +20% 16V
C 012	1.00	01A11000	CAP CER .01uF 20% 50V
C 013	1.00	01H61000A1	CAP AL EL 1000uF -20 +20% 35V
D 001	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
D 002	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
D 003	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
D 004	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
D 005	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
D 006	1.00	03E04001	DIODE RECTIFIER 1N4001 50V 1A
D 007	1.00	03J00001	DIODE BRIDGE 400V 1.5A
D 008	1.00	03J00001	DIODE BRIDGE 400V 1.5A
D 012	1.00	03J00001	DIODE BRIDGE 400V 1.5A
IC 001	1.00	10C00317	IC REG POS 317 .5A TO-202
IC 002	1.00	10D00337	IC REG NEG 337 .5A TO-202
IC 003	1.00	10A07805A1	IC REG POS 78M05 5V .5A
J 001	1.00	19K00019	CONN MOLEX 9 COND ML LOCK WFR
J 002	1.00	19K00019	CONN MOLEX 9 COND ML LOCK WFR
R 001	1.00	12EC8200	RES CARBON 82 OHM 5% 2W
R 002	1.00	12B11100	RES CARBON 11K 5% 1/4W
R 003	1.00	12FD5230	RES MET FLM 523 OHM 1% 1/4W
R 004	1.00	12B17500	RES CARBON 75K 5% 1/4W
R 005	1.00	12F03160	RES MET FLM 3.16K 1% 1/4W
R 006	1.00	12B16800	RES CARBON 68K 5% 1/4W
R 007	1.00	12F03160	RES MET FLM 3.16K 1% 1/4W
R 008	1.00	12B11100	RES CARBON 11K 5% 1/4W
R 009	1.00	12FD5230	RES MET FLM 523 OHM 1% 1/4W
R 010	1.00	12EC8200	RES CARBON 82 OHM 5% 2W

PART: 4301-105
DESC: POWER SUPPLY ASSY

REFERENCE INFORMATION	QTY PER ASSEMBLY	COMPONENT PART	DESCRIPTION
R 011	1.00	12EC6200	RES CARBON 62 OHM 5% 2W
	3.00	23G00017	HEATSINK
	3.00	23J00010	TRANSISTOR INSULATOR TO-220
	3.00	24Z00022	WASHER COMPRESS #4 SCP
	3.00	24A04210	NUT HEX #4 SS
	3.00	24A04004B2	SCREW 4-40x1/4 PH-CR-SS NYLK
	1.00	F4301-502	PCB POWER SUPPLY
REF	0.00	C4301-503	COMPONENT LAYOUT POWER SUPPLY
REF	0.00	D4301-504	SCHEMATIC DIAGRAM POWER SUPPLY
REF	0.00	B4301-510	HEATSINK MODIFICATION DWG
REF	0.00	TP4301-5	4301 POWER SUPPLY BD TEST PROC

17. COMPONENT LAYOUTS AND SCHEMATIC DIAGRAMS

1701. This section contains the component layout and schematic diagram for the following Model 43-01 assemblies:

FIGURE	TITLE	PAGE NUMBER
17	Interface Board, Component Layout	17-2
18	Interface Board, Schematic Diagram	17-3
19	Digital Board, Component Layout	17-4
20	Digital Board, Component Diagram	17-5
21	Generator Board, Component Layout	17-6
22	Generator Board, Schematic Diagram	17-7
23	Analog Board, Component Layout	17-8
24	Analog Board, Schematic Diagram	17-9
25	I/O Board, Component Layout	17-10
26	I/O Board, Schematic Diagram	17-11
27	Power Supply, Component Layout	17-12
28	Power Supply, Schematic Diagram	17-13

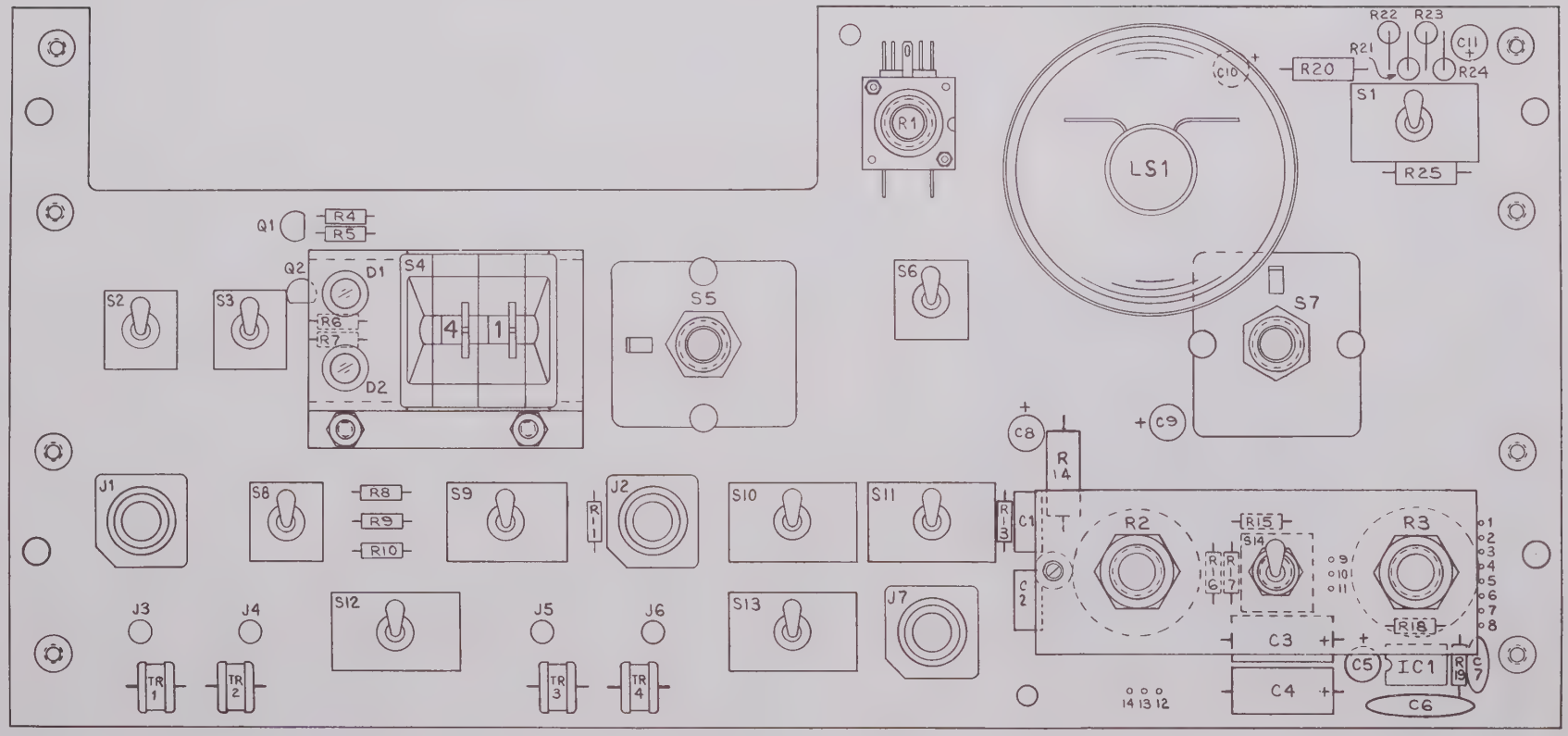


Figure 17. Interface Board, Component Layout

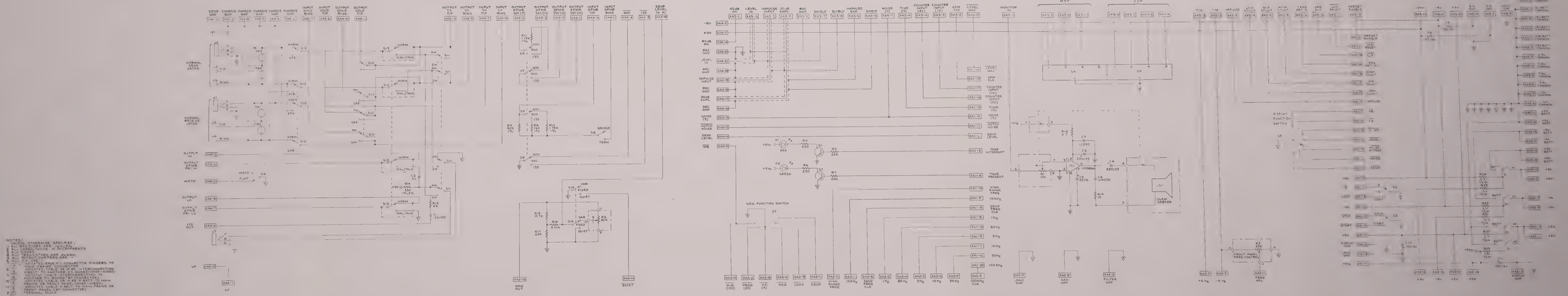


Figure 18. Interface Board, Schematic Diagram

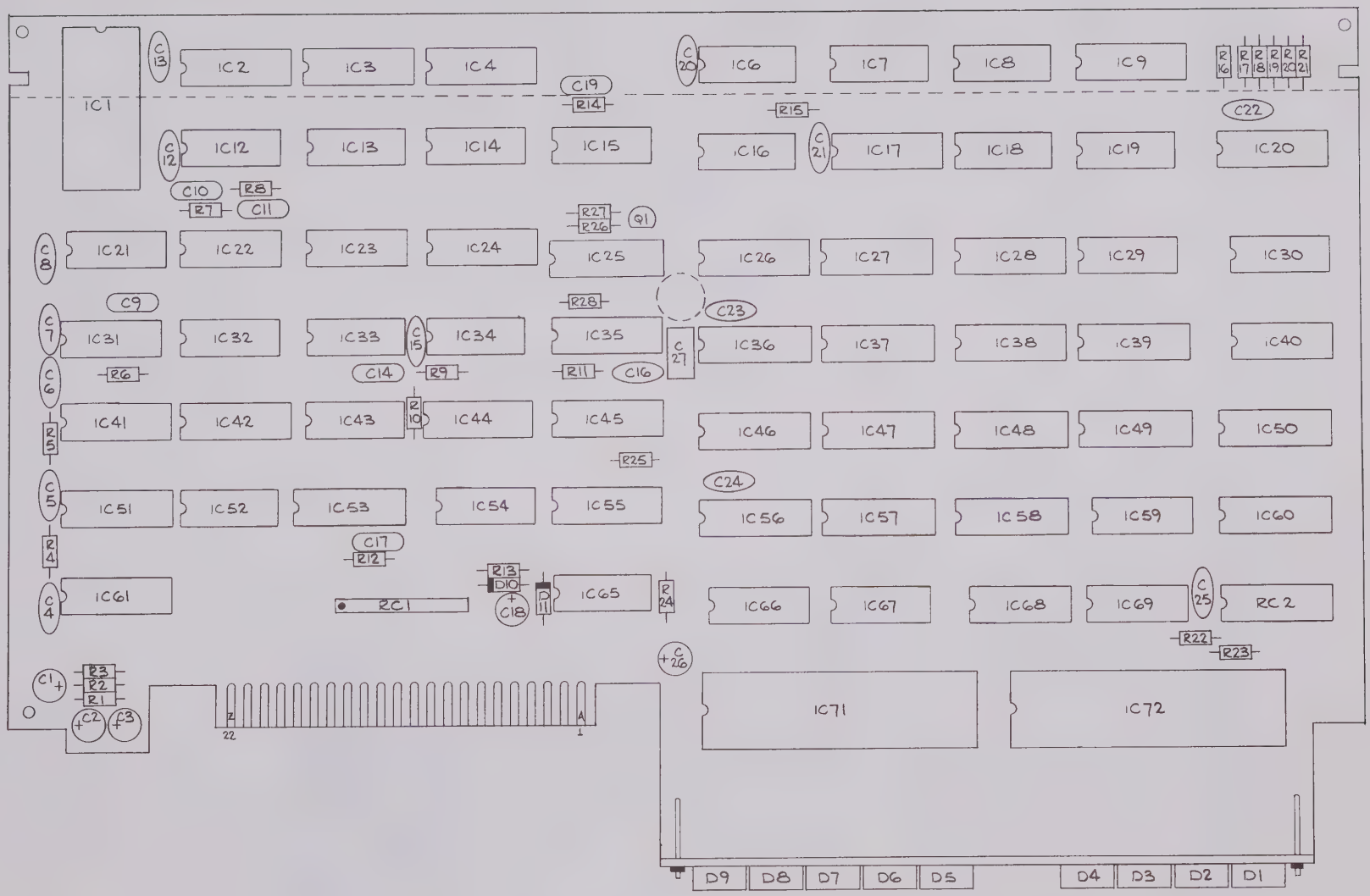


Figure 19. Digital Board, Component Layout

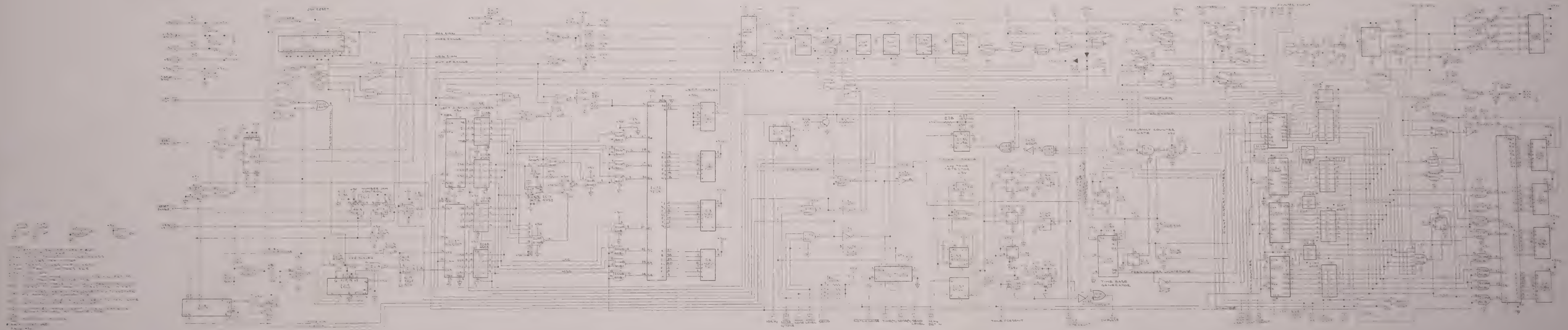


Figure 20. Digital Board, Schematic Diagram

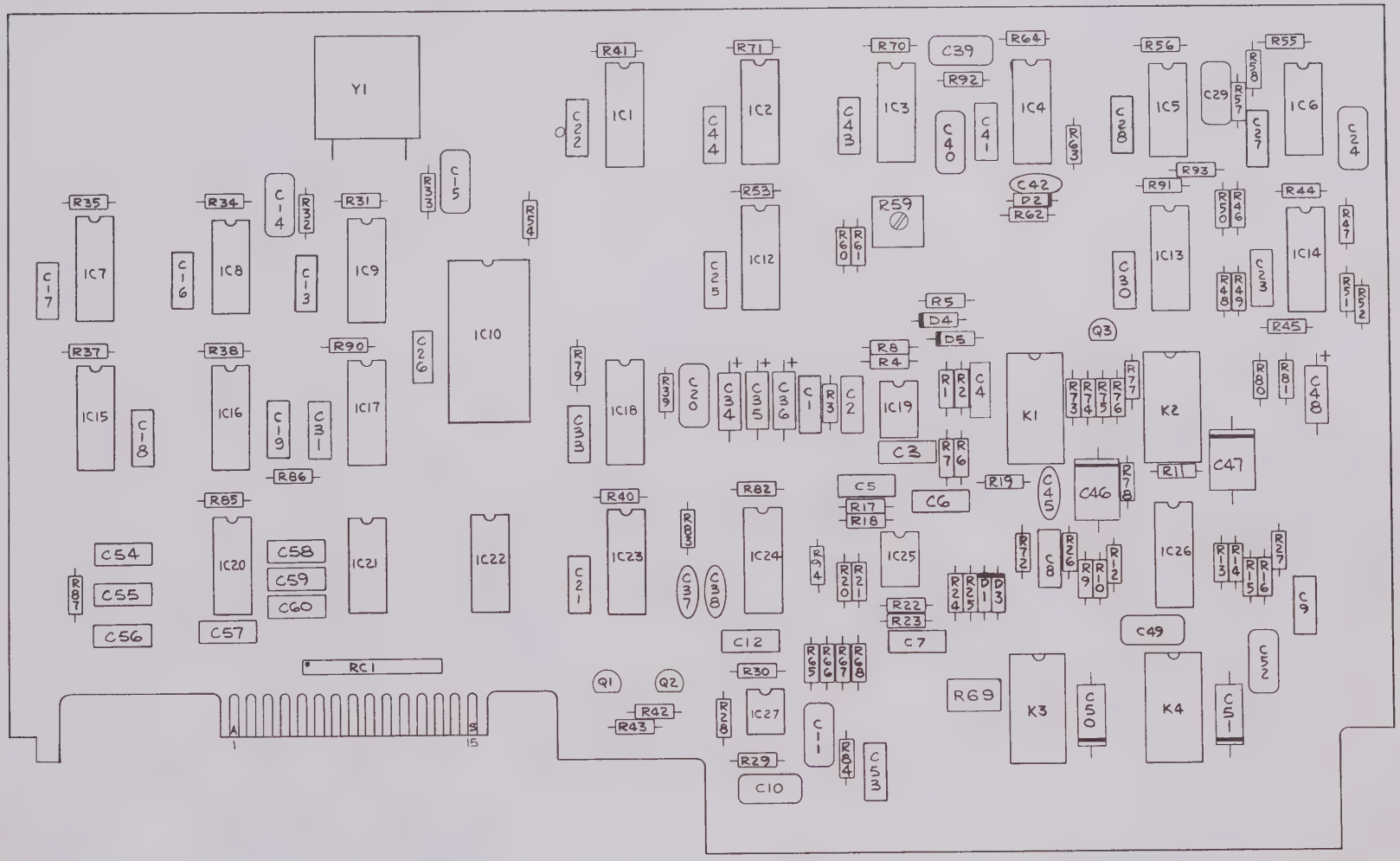
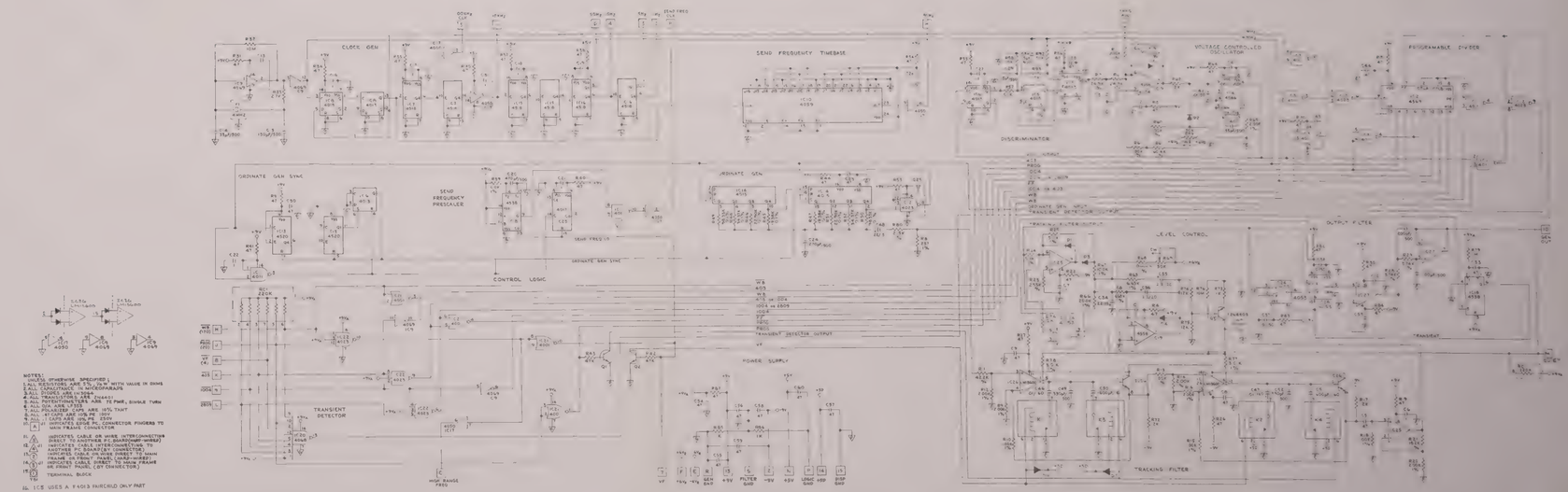


Figure 21. Generator Board, Component Layout



NOTES:
1. UNLESS OTHERWISE SPECIFIED
   ALL RESISTANCE IS IN OHMS WITH VALUE IN OHMS
2. ALL CAPACITANCE IS MICROFARADS
3. ALL DIODES ARE IN3064
4. ALL TRANSISTORS ARE 2N5461
5. ALL POTENTIOMETERS ARE 75 PWR, SINGLE TURN
6. ALL R/A ARE 4732
7. ALL RESISTORS ARE 10% TANT
8. ALL CAPS ARE 10% PE 100V
9. ALL CAPS ARE 10% PE 250V
10. [A] INDICATES PC CARD CONNECTOR FINGERS TO MAIN FRAME CONNECTOR
11. INDICATES CABLE OR WIRE INTERCONNECTION DIRECT TO ANOTHER PC BOARD(COMP-WIREP)
12. INDICATES CABLE INTERCONNECTING TO ANOTHER PC BOARD VIA MAIN FRAME
13. INDICATES CABLE OR WIRE DIRECT TO MAIN FRAME OR FRONT PANEL (MAP)-WIREP)
14. INDICATES CABLE OR WIRE TO MAIN FRAME OR FRONT PANEL (ET CONNECTOR)
15. TB TERMINAL BLOCK
16. IC5 USES A F403 FAIRCHILD ONLY PART

Figure 22. Generator Board, Schematic Diagram

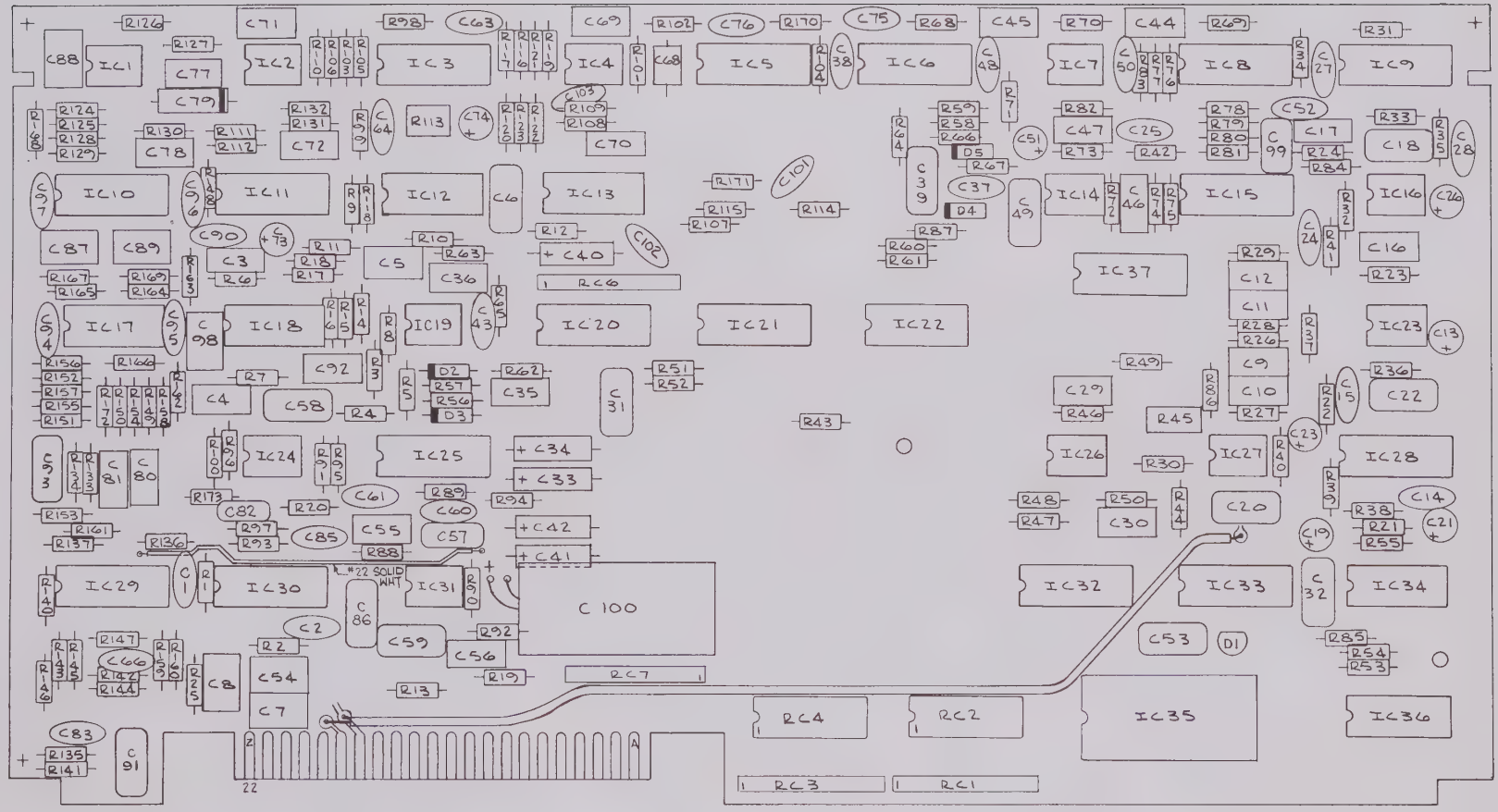


Figure 23. Analog Board, Component Layout

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
2. ALL RESISTORS ARE 1/4W, 5%
3. ALL CAPACITANCE IN MICROFARADS
4. ALL DIODES ARE IN3064
5. ALL POTENTIOMETERS ARE 1% PWR. ONE TURN
6. ALL IC'S ARE MC 4558
7. [P] INDICATES EDGE P.C. CONNECTOR FINGERS TO MAIN FRAME CONNECTOR
8. INDICATES CABLE OR WIRE INTERCONNECTION BETWEEN P.C. BOARDS (HARD-WIRED) OR INDICATES CABLE INTERCONNECTION TO ANOTHER P.C. BOARD (EF CONNECTOR)
9. INDICATES CABLE OR WIRE DIRECT TO MAIN FRAME OR FRONT PANEL (HARD-WIRED)
10. INDICATES CABLE DIRECT TO MAIN FRAME OR FRONT PANEL (EF CONNECTOR)
11. TERMINAL BLOCK
12. # FACTORY SELECT

Figure 24. Analog Board, Schematic Diagram

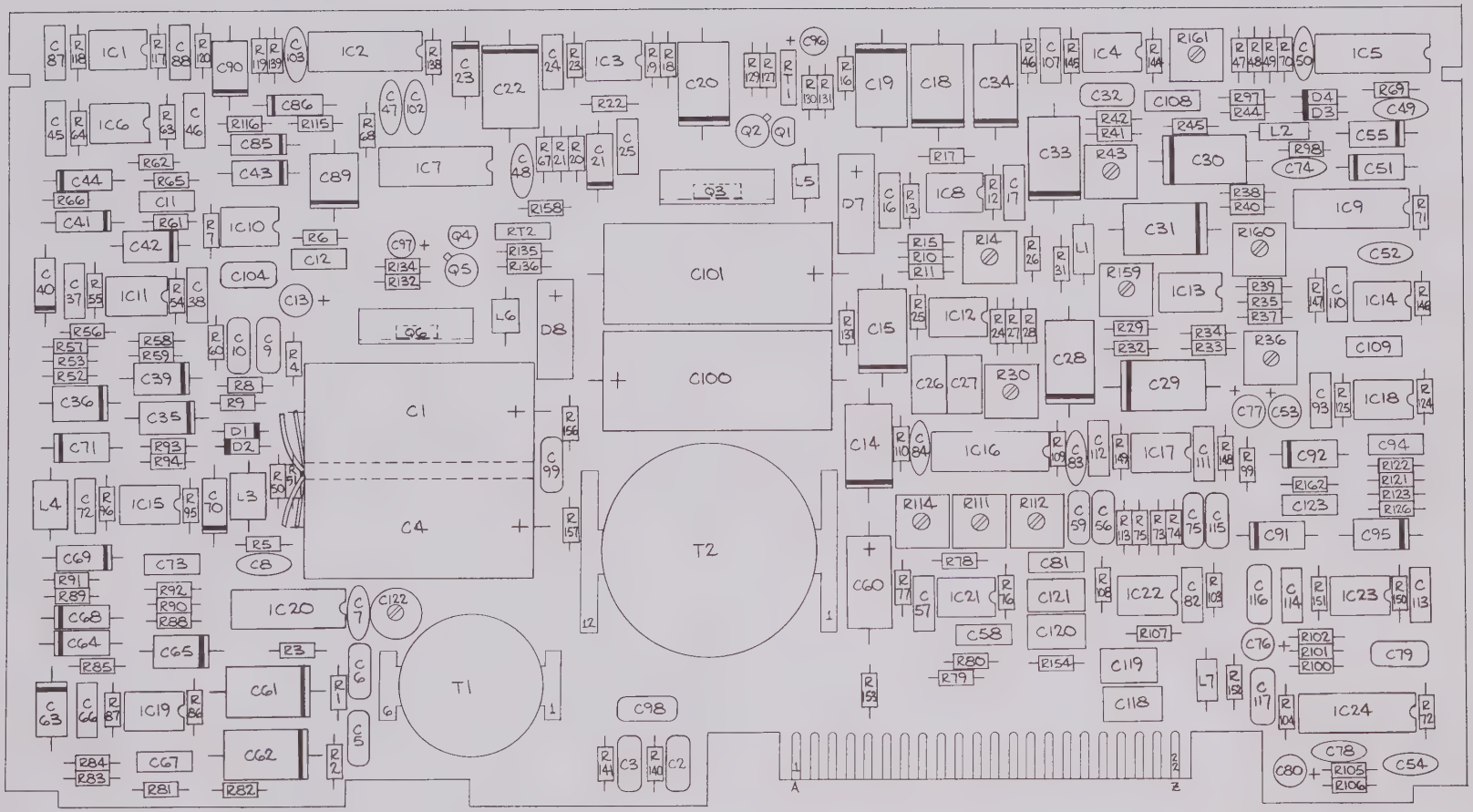
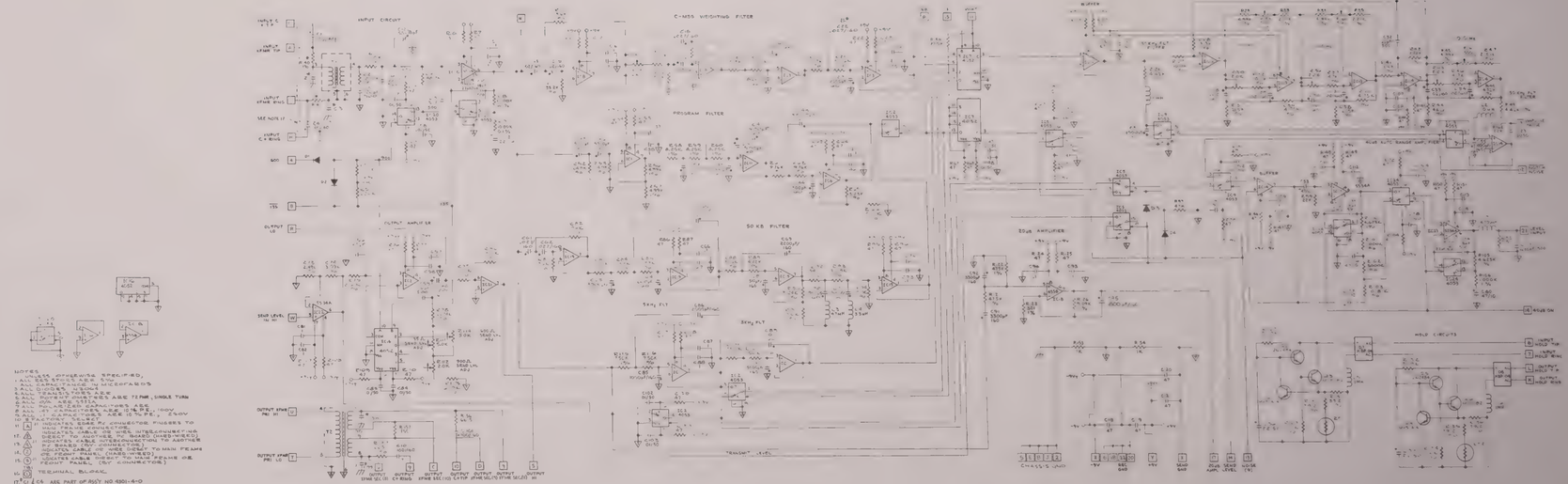


Figure 25. I/O Board, Component Layout



NOTES
1. UNLESS OTHERWISE SPECIFIED,
2. ALL RESISTANCE IN MEGAOHMS
3. ALL DIODES 1N5061
4. ALL POTENTIOMETERS ARE 7/8 PWR, SINGLE TURN
5. ALL VR RESISTORS
6. ALL CAPACITORS ARE 1/4 PC, 100V
7. ALL T CAPACITORS ARE 10 % PC, 250V
8. ALL C CAPACITORS
9. ⊙ INDICATES SMB PC CONNECTOR PLUGS TO MAIN FRAME CONNECTORS
10. ⊙ INDICATES CABLE INTERCONNECTING TO ANOTHER PC BOARD (HARDWIRED)
11. ⚠ INDICATES CABLE INTERCONNECTING TO ANOTHER PC BOARD (CONNECTORIZED)
12. ⚠ INDICATES CABLE OF WIRE DENOTED TO MAIN FRAME
13. ⊙ OR FRONT PANEL (HARD WIRED)
14. ⊙ INDICATES CABLE TO MAIN FRAME OR FRONT PANEL (BY CONNECTOR)
15. ⊙ TERMINAL BLOCK
16. ⊙ C1 & C4 ARE PART OF ASSY NO 4301-4-0

Figure 26. I/O Board, Schematic Diagram

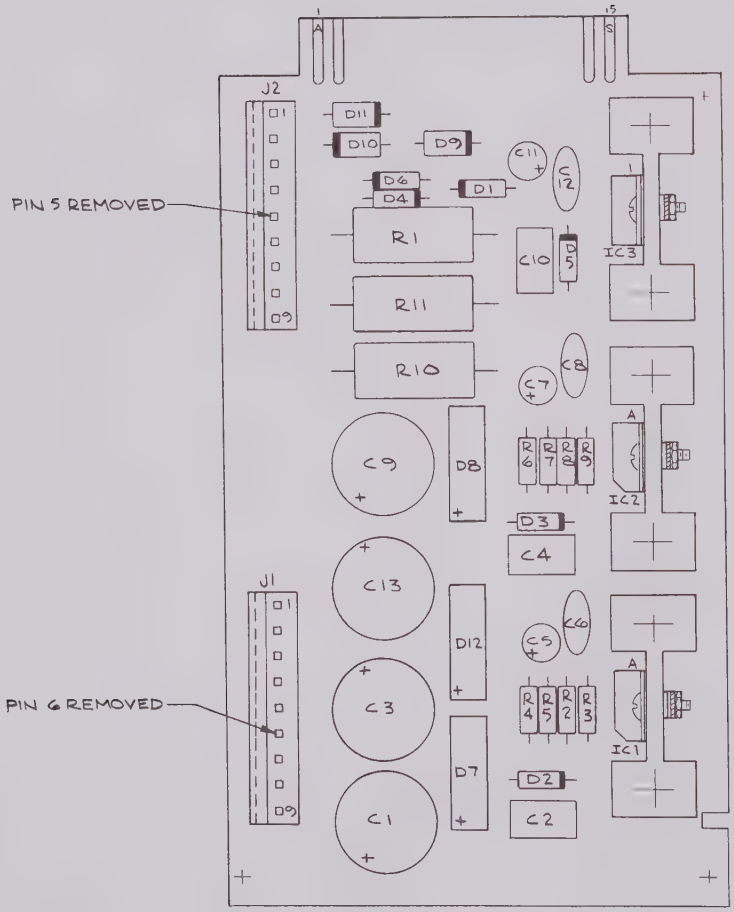


Figure 27. Power Supply, Component Layout

NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE 5%, 1/4W
2. ALL CAPACITANCE IN MICROFARADS
3. ALL DIODES IN 4001
4. ALL TRANSISTORS ARE
5. ALL POTENTIOMETERS ARE
6. ALL O/A ARE
7. □ J INDICATES EDGE P.C. CONNECTOR FINGERS TO MAIN FRAME CONNECTOR
8. ⚠ INDICATES CABLE OR WIRE INTERCONNECTING DIRECT TO ANOTHER P.C. BOARD (HARD WIRE)
9. △ J INDICATES CABLE INTERCONNECTING TO ANOTHER P.C. BOARD (BY CONNECTOR)
10. (E) INDICATES CABLE OR WIRE DIRECT TO MAIN FRAME OR FRONT PANEL (HARD-WIRED)
11. (3) J INDICATES CABLE DIRECT TO MAIN FRAME OR FRONT PANEL (BY CONNECTOR)
12. □ TB1 TERMINAL BLOCK

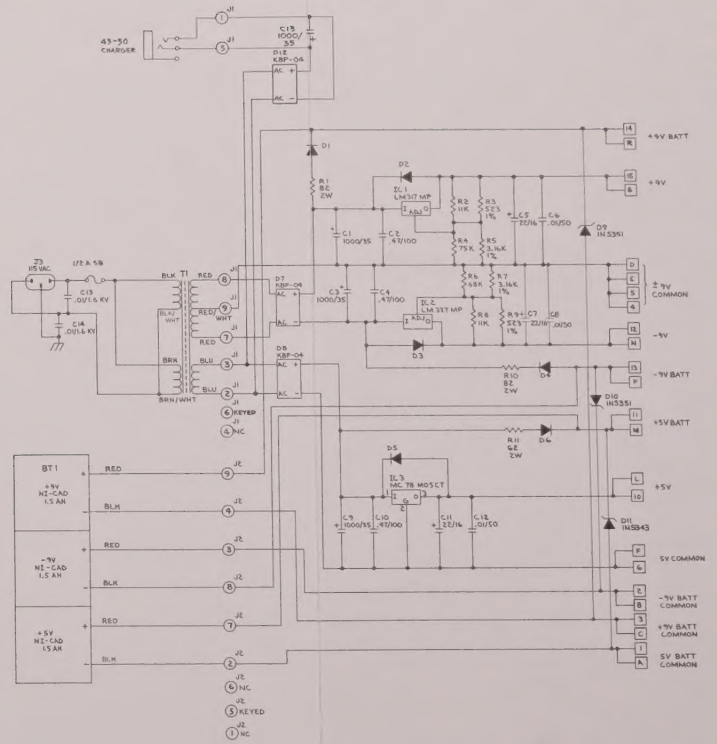


Figure 28. Power Supply, Schematic Diagram

www.manualsplus.com
1029962